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AXIOM Artis VA20F / VA21x / VA22x

[redacted] AX

DICOM Conformance Statement

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Network Conformance Statement

1 Introduction

1.1 Overview

The Conformance Statement describes the DICOM interface for the Siemens AXIOM Artis in terms of part 2 of [DICOM].

1.2 Scope and Field

The Siemens product AXIOM Artis is a Cardiac/Angio/Multi-purpose Interventional System for Acquisition and Viewing of Images. The AXIOM Artis is designed for integration into an environment of medical DICOM-based devices. AXIOM Artis supports the storage of images utilizing the DICOM “Storage Service Class” as SCU and SCP. The retrieval of Images from a PACS System utilizing the DICOM “Query/Retrieve Service Class” as an SCU is supported as well as SCP to support other systems that want to browse the contents of the Artis database and retrieve images from it. Printing of images on a printer utilizing the DICOM “Print Management Service ” as an SCU is supported too. The “Modality Worklist Service” us supported to minimize patient data input during Patient Registration. Furthermore the handling of CD offline media is supported as a FSC, FSU and FSR.

1.3 Audience

This document is intended for hospital staff, health system integrators, software designers or implementers. It is assumed that the reader has a working understanding of DICOM.

1.4 Remarks

DICOM, by itself, does not guarantee interoperability. However, the Conformance Statement facilitates a first-level validation for interoperability between different applications supporting the same DICOM functionality as SCU and SCP, respectively.

This Conformance Statement is not intended to replace validation with other DICOM equipment to ensure proper exchange of information intended.

The scope of this Conformance Statement is to facilitate communication with Siemens and other vendors' Medical equipment. The Conformance Statement should be read and understood in conjunction with the DICOM 3.0 Standard [DICOM]. However, by itself it is not guaranteed to ensure the desired interoperability and a successful interconnectivity.

The user should be aware of the following important issues:

- The comparison of different conformance statements is the first step towards assessing interconnectivity between Siemens and non-Siemens equipment.
- Test procedures should be defined and tests should be performed by the user to validate the connectivity desired. DICOM itself and the conformance parts do not specify this.
- The standard will evolve to meet the users' future requirements. Siemens is actively involved in developing the standard further and therefore reserves the right to make changes to its products or to discontinue its delivery.
- Siemens reserves the right to modify the design and specifications contained herein without prior notice. Please contact your local Siemens representative for the most recent product information.

1.5 Definitions, Terms and Abbreviations

Definitions, terms and abbreviations used in this document are defined within the different parts of the DICOM standard.

Additional Abbreviations and terms are as follows:

ACR	American College of Radiology
AE	DICOM Application Entity
ASCII	American Standard Code for Information Interchange
CSE	Customer Service Engineer
DB	Database
DCS	DICOM Conformance Statement
DSA	Digital Subtraction Angiography
IOD	DICOM Information Object Definition
ISO	International Standard Organization
NEMA	National Electrical Manufacturers Association
O	Optional Key Attribute
R	Required Key Attribute
RIS/HIS	Radiology Information System/Hospital Information System
PDU	DICOM Protocol Data Unit
RWA	Real-World Activity
SCU	DICOM Service Class User (DICOM client)
SCP	DICOM Service Class Provider (DICOM server)
SOP	DICOM Service-Object Pair
U	Unique Key Attribute
UI	User Interface

1.6 References

[DICOM] Digital Imaging and Communications in Medicine (DICOM), NEMA PS 3.1-3.14, 1999

1.7 Structure

The AXIOM Artis Conformance Statement is subdivided into three Parts, which relate to individual documents needed to declare Conformance according to the requirements of "Part 2 - Conformance" of the DICOM Standard.

Those parts are:

- The "DICOM Conformance Statement" for Network related Services
- A privately defined "Application Profile"
- The "Offline Media Conformance Statement" to support local archive media.
- A general Appendix.

2 Implementation Model Verification

The Siemens AXIOM Artis DICOM Service Tool application requests Verification to verify the ability of a foreign DICOM application on a remote node to respond to DICOM messages.

Responding to Verification requests from remote nodes is handled by the Storage SCP application.

2.1 Application Data Flow Diagram

The AXIOM Artis DICOM network implementation is a Windows NT application and acts as SCU for the C-ECHO DICOM network service.

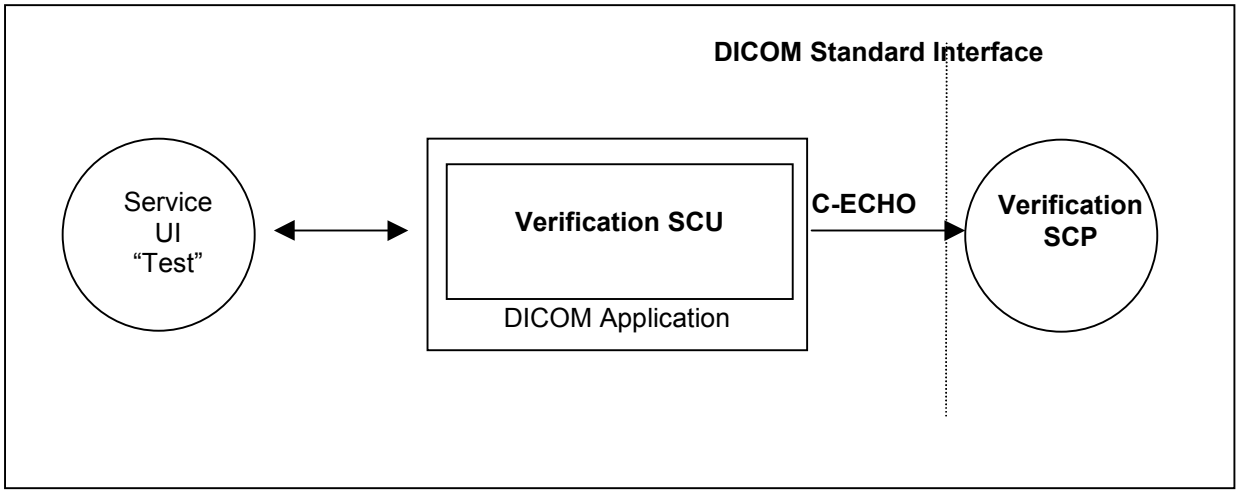


Figure 1: AXIOM Artis Application Flow Diagram - Verification SCU

2.2 Functional Definitions of Applications

The AXIOM Artis DICOM Service Tool application opens an association when a "Test" of a remote application is requested during a configuration session. This can be done when entering new data for remote application configuration or to verify existing configuration data.

2.3 Sequencing of Real-World Activities

Not applicable

3 Application Entity Specification Verification

3.1 Verification AE Specification

3.1.1 Association Establishment Policies

3.1.1.1 General

The AXIOM Artis DICOM Service Tool application attempts to open an association for verification request whenever the "Test" function is activated during network configuration of a remote DICOM application.

3.1.1.2 Number of Associations

The AXIOM Artis DICOM Service Tool application initiates one association at a time to request verification.

3.1.1.3 Asynchronous Nature

The AXIOM Artis DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

3.1.1.4 Implementation Identifying Information

Implementation Class UID	1.3.12.2.1107.5.9.990801
Implementation Version Name	“SIEMENS_SWFVA47W"

3.1.2 Association Initiation Policy

The AXIOM Artis DICOM Service Tool application attempts to initiate a new association for

- DIMSE C-ECHO

service operations.

3.1.2.1 Associated Real-World Activity

3.1.2.1.1 Associated Real-World Activity – Request Verification

The associated Real-World activity is a C-ECHO request initiated by Service and Configuration SW environment whenever a "Test" is requested. If an association to a remote Application Entity is successfully established, Verification with the configured AET is requested via the open association. If the C-ECHO Response from the remote Application contains a status other than "Success" this will be indicated in the service environment and the association is closed.

3.1.2.1.2 Proposed Presentation Contexts

The AXIOM Artis DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table – Verification SCU					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.1.3 SOP Specific Conformance – Verification SCU

None.

3.1.3 Association Acceptance Policy

The Verification SCP is part of the Storage SCP – see section 5.1.3.

4 Implementation Model Storage

The Siemens AXIOM Artis DICOM Application Entity both originates associations for Storage of DICOM Composite Information Objects in Remote Application Entities and receives association requests for Storage from Remote Application Entities.

4.1 Application Data Flow Diagram

The AXIOM Artis DICOM network implementation is a Windows NT application and acts as SCU and SCP for the C-STORE DICOM network service and as SCP for the C-ECHO DICOM network service.

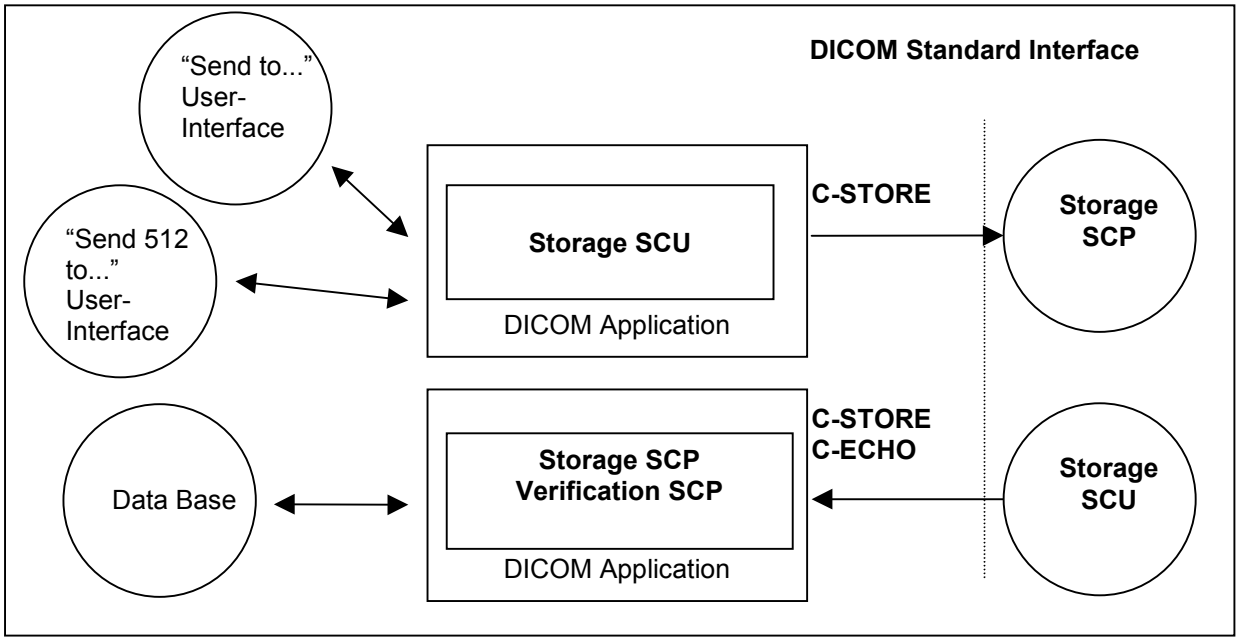


Figure 2: AXIOM Artis Application Data Flow Diagram – Storage SCU/SCP, Echo SCP

4.2 Functional Definitions of Application Entities

The Storage SCU is invoked by the job control interface that is responsible for processing network archival tasks. The job consists of data describing the composite image objects selected for storage and the destination. An association is negotiated with the destination application entity and the image data is transferred using the C-STORE DIMSE-Service. Status of the transfer is reported to the job control interface. Sending can also be activated by the "Send 512 to..." interface of the DSA Viewer. It can be configured that sending in 512 format is the default mode of operation for the viewer's send functionality.

The Storage SCP component of the AXIOM Artis DICOM application is operating as background server process. It is existing when the machine is powered on and waits for Storage association requests. Upon accepting an association with a negotiated Presentation Context it starts to receive the Composite Image Objects and imports them to local database. Verification requests will be processed and responded by Storage SCP component too.

4.3 Sequencing of Real-World Activities

Not applicable

5 Application Entity Specification Storage

5.1 Storage AEs Specification

The AXIOM Artis Storage service class user/service class provider applications use one AE when initiating/receiving associations to/from remote DICOM nodes.

SIEMENS AXIOM Artis DICOM products provide Standard Conformance to the following DICOM V3.0 SOP Classes as an SCU:

SOP Class Name	SOP Class UID
X-Ray **A**ngiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1

SIEMENS AXIOM Artis DICOM products provide Private Conformance to the following DICOM V3.0 conform private SOP Classes as an SCU:

SOP Class Name	SOP Class UID
CSA Non-Image Storage	1.3.12.2.1107.5.9.1

SIEMENS AXIOM Artis DICOM products provide Standard Conformance to the following DICOM V3.0 SOP Classes as an SCP:

SOP Class Name	SOP Class UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
X-Ray **A**ngiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
Verification	1.2.840.10008.1.1

SIEMENS AXIOM Artis DICOM products provide Private Conformance to the following DICOM V3.0 conform private SOP Classes as an SCP:

SOP Class Name	SOP Class UID
CSA Non-Image Storage	1.3.12.2.1107.5.9.1

5.1.1 Association Establishment Policies

5.1.1.1 General

The existence of a job queue entry with network destination will activate the DICOM Storage Application. An association request is sent to the destination AE and upon successful negotiation of a Presentation Context the transfer is started.

The default PDU size used will be 28 KB.

5.1.1.2 Number of Associations

The Siemens AXIOM Artis DICOM application initiates several associations at a time, one for each destination to which a transfer request is being processed in the active job queue list.

5.1.1.3 Asynchronous Nature

The Siemens AXIOM Artis DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

5.1.1.4 Implementation Identifying Information

Implementation Class UID	1.3.12.2.1107.5.9.990801
Implementation Version Name	"SIEMENS_SWFVA47W"

5.1.2 Association Initiation Policy

If a job with network destination gets active in the job list the Siemens AXIOM Artis DICOM application attempts to initiate a new association for

- DIMSE C-STORE

service operations.

5.1.2.1 Associated Real-World Activity

5.1.2.1.1 Associated Real-World Activity – Send Image Objects to a Network Destination

The associated Real-World activity is a C-STORE request initiated by an internal daemon process triggered by a job with network destination. If the process successfully establishes an association to a remote Application Entity, it will transfer each image one after another via the open association. If the C-STORE Response from the remote Application contains a status other than “Success” or “Warning”, the association is aborted.

5.1.2.1.2 Proposed Presentation Context – Send Images

The Siemens AXIOM Artis DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
X-Ray **A**ngiographic Image Storage Service Class	1.2.840.10008.5.1.4.1.1.12.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCU	None
CSA Non-Image Storage	1.3.12.2.1107.5.9.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCU	None

5.1.2.1.3 SOP specific Conformance Statement

The AXIOM Artis itself will create XA IOD type images from image acquisition and postprocessing applications. Furthermore a private "Non-Image IOD" will be used to store large numerical data and textual report results (e.g. Study Report, Quantification Results). The XA IOD will be a "Standard Extended XA Storage" SOP Class.

The AXIOM Artis (DICOM) application will not change private attributes as long as no modification is done. During a "Store Monitor" or "Store Reference Image" operation all private attributes not defined within the AXIOM Artis DICOM application will be removed when the new object instance is created.

5.1.2.1.3.1 Optional Attributes

Data Dictionary of DICOM Type 2 and 3 IOD Attributes

Please see "A.4: overview of supplied attributes – X-Ray Angiographic image (Original, Derived)" and "A.6: overview of supplied attributes – X-Ray Angiographic image (Quant Report Image)" in the Appendix for a list of all DICOM IOD attributes of type 2 and 3 which are encoded by the AXIOM Artis applications.

5.1.2.1.3.2 Specialized Information Object Definitions

The DICOM images created by Siemens AXIOM Artis DICOM application conform to the DICOM IOD definitions (Standard extended IODs). But they will contain additional private elements, which have to be discarded by a DICOM system when modifying the image.

The DICOM nodes are responsible for data consistency when modifying images. All unknown private attributes have to be removed upon modification!

Data Dictionary of applied private IOD Attributes

Please see "A.2 Siemens Standard Extended Modules" in the Appendix for definition of the private attributes and the IOD tables in the Appendix for usage in the related IOD encoding.

5.1.2.1.3.3 Image Pixel Attribute Description for Grayscale Images

The Siemens AXIOM Artis DICOM application supports squared-sized images with the Monochrome2 Photometric Interpretation, the unsigned integer 16-bit grayscale pixel and graphic overlay format. The lower 12 bits are used for pixel and the higher 4 bits are used for the graphic overlay:

Pixel plane

- samples per pixel (attribute 0028, 0002) = 1
- photometric interpretation (attribute 0028,0004) = "MONOCHROME2"
- Rows (attribute 0028,0010) = 512, 1024
- Columns (attribute 0028,0011) = 512, 1024
- pixel representation (attribute 0028, 0103) = 0
- bits allocated (attribute 0028, 0100) = 8, 16
- bits stored (attribute 0028,0101) = 8, 12
- high bit (attribute 0028,0102) = 7, 11

Overlay plane

- overlay type (attribute 60xx, 0040) = "G"
- bits allocated (attribute 60xx, 0100) = 1
- bit position (attribute 60xx, 0102) = 0
- overlay data (attribute 60xx, 3000) = supported (with “bits allocated = 8”).

5.1.2.1.3.4 Private Information Object Definitions

To fulfill all application requirements, the AXIOM Artis DICOM implementation will use private IOD’s to store Data currently not defined in the DICOM Standard according the DICOM information model. The privately defined IOD will contain all references to identify the Patient/Study/Series/Images to which the related information belongs.

Currently this format is used for the “Study Report”.

All IOD used to store this private Information will be based on various Instances of the SIEMENS Non-Image IOD.

Please see "A.1:SIEMENS Private Non-Image IOD" and "A.5:Private Non-Image IOD" in the Appendix for a detailed overview of the private IOD definition and the IOD tables for value encoding.

5.1.2.1.4 Associated Real-World Activity - Send Image Objects 512 to a Network destination

From the Viewing application it is possible to issue special send requests for the job queue. The images in this case are "pre-processed" to be compliant to the Basic Cardiac Image definitions (512^2 Matrix with 8-Bits allocated). Consecutive to the pre-processing stage the transfer is processed as with the normal "Send to..." RWA.

5.1.2.1.5 Proposed Presentation Contexts - "Send 512 to ..."

The proposed Presentation Contexts for this RWA are identical to those described in section 5.1.2.1.2.

5.1.2.1.6 SOP Specific Conformance - "Send 512 to..."

The AXIOM Artis itself will create XA IOD type images from image acquisition and post-processing applications. Furthermore a private "Non-Image IOD" will be used to store numerical data and textual report results (e.g. Study Report). The XA IOD will be a "Standard Extended XA Storage" SOP Class.

The "Send 512 to..." will allow conversion of any image that is displayed in the AXIOM Artis DSA viewing application to an image that conforms to the Basic Cardiac format. Conversion is limited to reduction of Matrix Size and Pixel Depth and is restricted to be applied to "image-type" instances only. The converted image is a temporary copy and therefore a new Instance UID is generated.

Quant Report images will not be downsized and are sent “as is”.

The SOP Instance UID of the converted images will be created in a reproducible way by appending a ".512" to the original UID.

The conversion will generate a Pixel Matrix output that is described by the following Attribute values:

- [0029,0010] Rows = **512**
- [0028,0011] Columns = **512**
- [0028,0100] Bits allocated = **8**
- [0028,0101] Bits Stored = **8**
- [0028,0102] High Bit = **7**

In order to preserve integrity of the data with respect to the original Matrix Size and Pixel Depth, the following attributes will be adapted accordingly for the resulting image:

- [0018,1602] Shutter Left Vertical Edge
- [0018,1604] Shutter Right Vertical Edge
- [0018,1606] Shutter Upper Horizontal Edge
- [0018,1608] Shutter Lower Horizontal Edge
- [0018,1610] Center of Circular Shutter
- [0018,1612] Radius of Circular Shutter
- [0018,1702] Collimator Left Vertical Edge
- [0018,1704] Collimator Right Vertical Edge
- [0018,1706] Collimator Upper Horizontal Edge
- [0018,1708] Collimator Lower Horizontal Edge
- [0018,1710] Center of Circular Collimator
- [0018,1712] Radius of Circular Collimator

- [0018,1720] Vertices of the Polygonal Collimator
- [0018,1164] Imager Pixel Spacing
- [0028,1050] Window Center
- [0028,1051] Window Width
- [0028,3002] MOD LUT Descriptor
- [0028,3006] MOD LUT Data
- [6000,0010] Overlay Rows
- [6000,0011] Overlay Columns
- [6000,3000] Overlay Data

5.1.3 Association Acceptance Policy

The Siemens AXIOM Artis DICOM application attempts to accept a new association for

- DIMSE C-ECHO
- DIMSE C-STORE

service operations. Any Information Objects transmitted on that association will be checked on conformance and stored in database if check was successful.

5.1.3.1 Associated Real-World Activity

5.1.3.1.1 Associated Real-World Activity – Receiving Images from a Remote Node

The daemon receiving process will accept an association and will receive any images transmitted on that association and will store the images on disk in the own database if the conformance check is performed successfully.

5.1.3.1.2 Presentation Context Table

The Siemens AXIOM Artis DICOM application will accept Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
CT Image Storage Service Class	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
MR Image Storage Service Class	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None
X-Ray **A**ngiographic Image Storage Service Class	1.2.840.10008.5.1.4.1.1.12.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian JPEG Lossless, Process 14 (selection value 1) JPEG Lossy Baseline (Process 1) compression JPEG Lossy Extended (Process 2 & 4)	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	SCP	None
CSA Non-Image Storage	1.3.12.2.1107.5.9.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCP	None
Verification	1.2.840.10008.1.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCP	None

Note: JPEG compression Transfer Syntaxes are supported only for monochrome images (Photometric Interpretation = "MONOCHROME1" or "MONOCHROME2")

The AXIOM Artis DICOM storage provider will only accept MONOCHROMEx encoded images. Color encoded images (RGB or Palette Color) are not supported.

5.1.3.1.3 SOP-specific Conformance Statement

The Siemens AXIOM Artis DICOM application conforms to the Full Storage Class at Level **2**. In the event of a successful C-STORE operation, the image has successful been written on disk in the Siemens AXIOM Artis image format. For Private Attributes of VR=SQ, only a nesting level of one is supported. This means that Private Sequences containing another Sequence will be removed from the image header during Storage.

The AXIOM Artis DICOM receiver returns the status Success upon successful operation otherwise one of the following status codes is returned and the association is aborted:

- Refused (A700):
  This error status indicates a lack of Resources (e.g. not enough disk space) on the AXIOM Artis modality.
- Error (A900 or C000):
  An error occurred while processing the image, which makes it impossible to proceed. The image will not be stored and the association aborted.

If an image instance is received that is identified by a SOP Instance UID that is already used by an Instance stored in database, then the actual received image will be discarded. The existing Instance is not superseded.

The following sections will differentiate the attribute contents required for Image Viewing. The Siemens AXIOM Artis DICOM application supports more formats for Storage of Images.

5.1.3.1.3.1 Image Pixel Attribute Acceptance Criterion for Grayscale Images

The AXIOM Artis DSA Viewing application accepts the MONOCHROME1 and MONOCHROME2 photometric interpretation pixel format and graphic overlay with unsigned integer and 8 or 16 bits allocated. The Pixel Matrix has to be in square format. Accepted values:

Pixel plane

- samples per pixel (attribute 0028, 0002) = 1
- photometric interpretation (attribute 0028,0004) = "MONOCHROME1", "MONOCHROME2"
- Rows (attribute 0028,0010) = 512, 1024
- Columns (attribute 0028,0011) = 512, 1024
- pixel representation (attribute 0028, 0103) = 0
- bits allocated (attribute 0028, 0100) = 8, 16
- bits stored (attribute 0028,0101) = 8, 10, 12
- high bit (attribute 0028,0102) = 7, 9, 11

Overlay plane

- overlay type (attribute 60xx, 0040) = "G"
- bits allocated (attribute 60xx, 0100) = 16
- bit position (attribute 60xx, 0102) = 12, 13, 14, 15

Graphic Overlay will be shifted to fill Overlay Planes from Bit 12 and consecutive.

Overlay plane

- overlay type (attribute 60xx, 0040) = "G"
- bits allocated (attribute 60xx, 0100) = 1
- bit position (attribute 60xx, 0102) = 0
- overlay data (attribute 60xx, 3000) = supported

For MOD LUT, both the linear LUT (Rescale Slope/Intercept) and the MOD LUT SQ are supported and considered when pixel data is displayed. However there are two limitations. The MOD LUT SQ will be ignored in the following cases:

- signed pixels
- the pixel format is changed by the MOD LUT (e.g. 8bit -> 16bit)

If the MOD LUT SQ contains multiple LUTs, then only the first one is used.

For VOI LUT, only the linear LUT (Window Center/Width) is supported. The contents VOI LUT SQ are ignored.

With multi-frame images the Overlay Graphics is only supported as replication of the 1st frame's overlay data.

5.1.3.1.4 Presentation Context Acceptance Criterion

The AXIOM Artis DICOM application will accept any number of verification or storage SOP classes that are listed above. The number of presentation contexts accepted is limited to the maximum of 127 (DICOM limit). In the event that the Siemens AXIOM Artis DICOM application runs out of resources, it will reject the association request.

5.1.3.1.5 Transfer Syntax Selection Policies

The AXIOM Artis DICOM application currently supports

- the Implicit VR Little Endian, the Explicit VR Little Endian and Explicit VR Big Endian Transfer Syntaxes
- the JPEG Lossless Non-hierarchical Transfer Syntax
- the JPEG Baseline and JPEG Extended Transfer Syntaxes (JPEG Lossy).

Any proposed presentation context including one of these Transfer Syntaxes will be accepted. Any proposed presentation context that does not include one of these Transfer Syntaxes will be rejected.

With Implicit VR Little Endian Transfer Syntax the AXIOM Artis DICOM application will remove any Private Attributes not known to the application. Decision on removal of a Private Element is done if there is NO entry in the attribute-dictionary of the AXIOM Artis DICOM application.

Therefore any Explicit VR Transfer Syntax shall preferably be used by the Storage SCU's when sending Composite Image Instances to the AXIOM Artis DICOM application.

6 Implementation Model Query / Retrieve

The query/retrieve service class defines an application-level class of services which facilitates the management of images and patient data against the well-defined information model of DICOM and allows a DICOM AE to retrieve images from a remote DICOM node. The AXIOM Artis DICOM query/retrieve application supports the query/retrieve services to act as SCU and SCP.

6.1 Application Data Flow Diagram

The AXIOM Artis DICOM network implementation is a Windows NT application and acts as SCU and SCP for the query/retrieve network service.

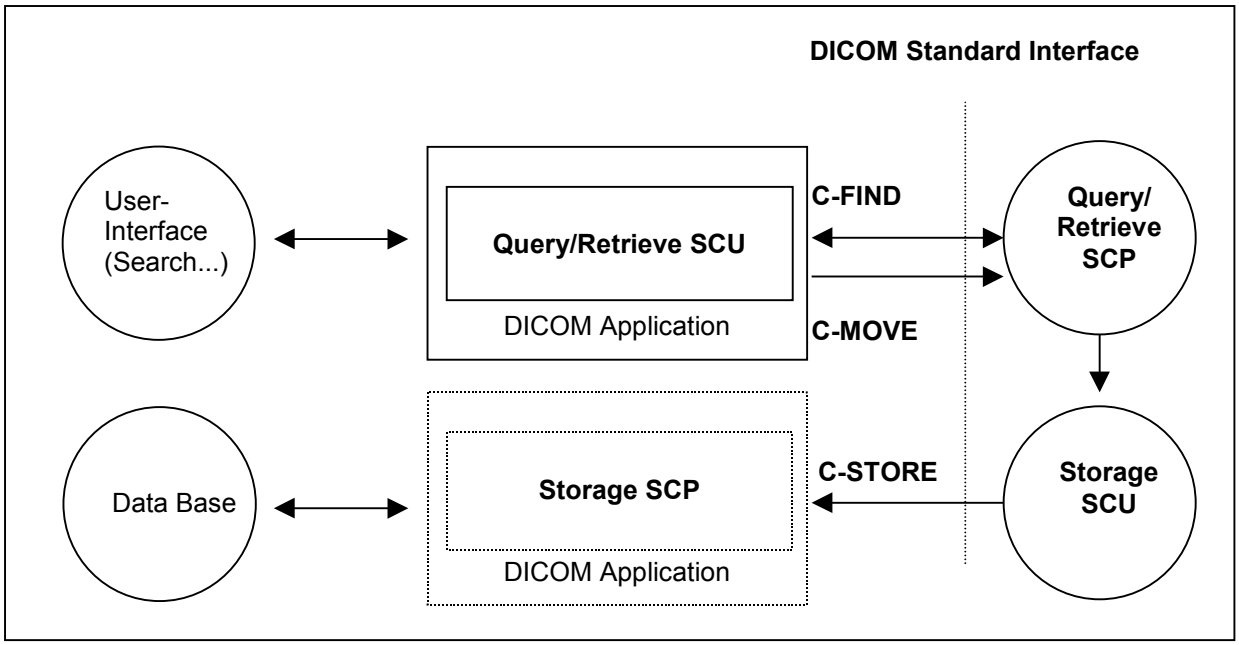


Figure 3: AXIOM Artis Application Data Flow Diagram – Query/Retrieve SCU

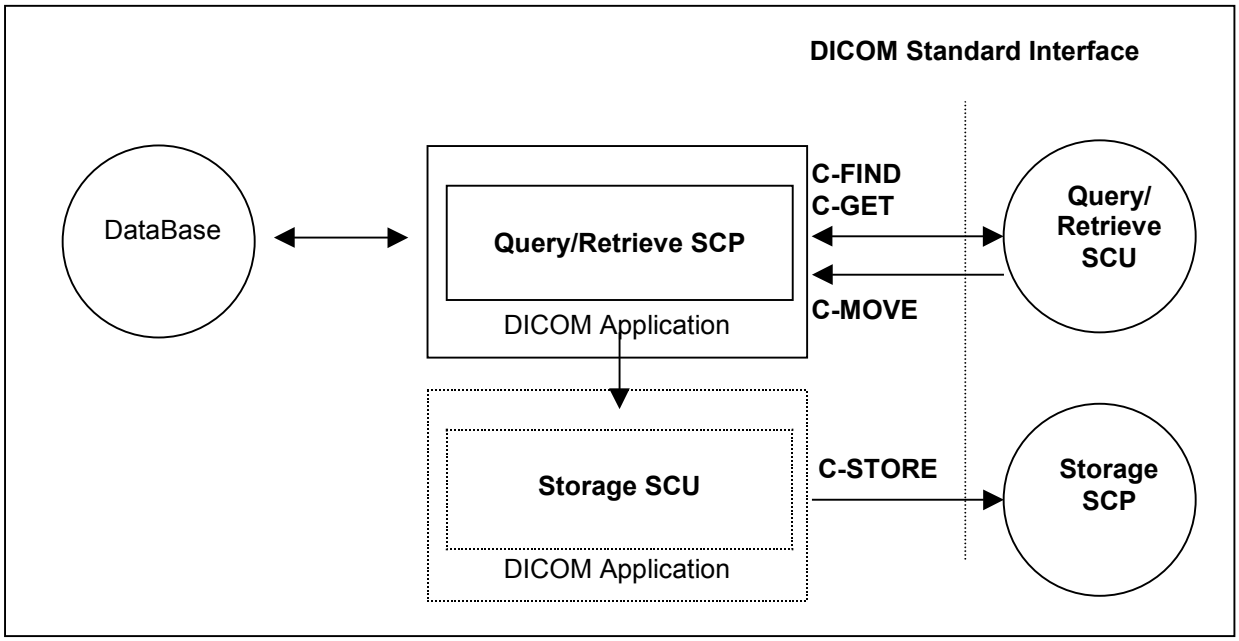


Figure 4: AXIOM Artis Application Data Flow Diagram – Query/Retrieve SCP

6.2 Functional Definitions of Application Entities

The AXIOM Artis DICOM query/retrieve SCU requests the remote query/retrieve SCP to perform a search and match to the keys specified in the request in order to display the results in the AXIOM Artis user interface. Depending on user action (Import) the AXIOM Artis DICOM SCU sends a C-MOVE DIMSE service to initiate a C-STORE sub-operation on the SCP to start an image transfer from remote Storage SCU (running on Query/Retrieve SCP) to the AXIOM Artis Storage SCP.

The AXIOM Artis DICOM query/retrieve SCP responds to C-FIND DIMSE services from remote SCU. Depending on further remote requests, a C-GET or a C-MOVE involves the Siemens AXIOM Artis DICOM query/retrieve SCP application to initiate a C-STORE association (by triggering and parametrizing the own Storage SCU) to send image objects to a remote Storage SCP.

All components of the Siemens DICOM query/retrieve SCP application are operating as background server processes. They are existing when the machine is powered on and then respond to queries based on the records stored in its database.

6.3 Sequencing of Real-World Activities

Retrieve of images is only possible if results from a previous “Search…” operation exist and those entities can be selected for “Import”.

7 Application Entity Specification Query/Retrieve

7.1 Query/Retrieve Service AEs Specification

The Query/Retrieve SCU requests that the remote SCP performs a match of all keys specified in the request, against the information in its database and the identified images will be moved over a different (C-MOVE) storage association.

The Query/Retrieve SCP responds to queries based on the records based on its database and images will be sent to the requesting SCU or to a different storage destination.

SIEMENS AXIOM Artis DICOM products provide Standard Conformance to the following DICOM V3.0 SOP Classes as SCU:

SOP Class Name	SOP Class UID
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2

SIEMENS AXIOM Artis DICOM products provide Standard Conformance to the following DICOM V3.0 SOP Classes as an SCP:

SOP Class Name	SOP Class UID
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Patient Root Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.1.3
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Study Root Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.2.3
Patient/Study Only Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1
Patient/Study Only Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2
Patient/Study Only Query/Retrieve Information Model - GET	1.2.840.10008.5.1.4.1.2.3.3

Note: See also the Storage DICOM Conformance Statement of the Siemens AXIOM Artis DICOM application to compare for conformance of the C-STORE sub-operation generated by the C-GET or C-MOVE DIMSE services. Furthermore compare the supported Storage Service SOP classes described in the Storage DICOM Conformance Statement of the Modality to which the images shall be transferred to.

7.1.1 Association Establishment Policies

7.1.1.1 General

With the "Search..." function the query data are input and the DICOM query/retrieve application is started. A query request will be sent out to one or more remote nodes and the response data will be displayed for the user. Upon request (Import), the retrieval of selected items is initiated.

The default PDU size used will be 28 KB.

7.1.1.2 Number of Associations

The Siemens AXIOM Artis DICOM application initiates one association for each query request being processed to a remote node. The maximum number of active associations is configurable.

7.1.1.3 Asynchronous Nature

The Siemens AXIOM Artis DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

7.1.1.4 Implementation Identifying Information

Implementation Class UID	1.3.12.2.1107.5.5.9.990801
Implementation Version Name	"SIEMENS_SWFVA47W"

7.1.2 Association Initiation Policy

The query user interface will request the query-data from the user and triggers one C-FIND request to the selected remote node. The response data will be displayed in the query UI for further data navigation.

When requesting Import of related items the browser requests the retrieve application to send a C-MOVE request to the related remote node. Images will then be received by the Storage SCP as described in the related section.

7.1.2.1 Real World Activity - Find SCU

7.1.2.1.1 Associated Real-World Activity - Find SCU (Search…)

The associated Real-World activity is to fill out a query form with search data and start the search query. The DICOM application creates a query identifier and issues a C-FIND over a previously build association. The remote SCP will respond with related data-entries that will be passed to a browser application. When data transfer is finished the association is closed.

7.1.2.1.2 Proposed Presentation Contexts - Find SCU

The Siemens AXIOM Artis DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCU	None
Study Root Query/Retrieve Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCU	None

It is configurable which of the two query models (or both) are to be used by the AXIOM Artis DICOM Query SCU application.

7.1.2.1.3 SOP Specific Conformance Statement - Find SCU

The Siemens AXIOM Artis DICOM Query/Retrieve SCU supports hierarchical queries with all mandatory search keys. The following table describes the search keys for the different query models that the SCU supports.

Attribute Name	Tag	Type	Matching	User Input	Return Value Display
Patient Level					
Patient Name[a]	(0010,0010)	R	Wildcard	Enter value	yes
Patient ID[b]	(0010,0020)	U / R	Wildcard	Enter value	yes
Patient´s Birthdate	(0010,0030)	O	Universal(Null)	--	yes
Patient´s Sex	(0010,0040)	O	Universal(Null)	--	yes
Study Level					
Study Instance UID	(0020,000D)	U	Single value	Select from List	--
Study ID	(0020,0010)	R	Universal(Null)	--	--
Study Date	(0008,0020)	R	Universal(Null)	--	yes
Study Time	(0008,0030)	R	Universal(Null)	--	yes
Accession Number	(0008,0050)	R	Universal(Null)	--	yes
Study Description	(0008,1030)	O	Universal(Null)	--	yes
Series Level					
Series Instance UID	(0020,000E)	U	Single Value	Select from List	--
Series Number	(0020,0011)	R	Universal(Null)	--	yes
Modality	(0008,0060)	R	Universal(Null)	--	yes
Series Date	(0008,0021)	O	Universal(Null)	--	yes
Series Time	(0008,0031)	O	Universal(Null)	--	yes
Series Description	(0008,103E)	O	Universal(Null)	--	yes
Image Level					
SOP Instance UID	(0008,0018)	U	Single Value	--	--
Image Number	(0020,0013)	R	Universal(Null)	--	yes

[a] In the Patient Name always a "*" is added
[b] In the Patient ID always a "*" is added

The Find SCU interprets following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources	A700	(0000,0902)
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	Cxxx	(0000,0901) (0000,0902)
Cancel	Matching terminated due to Cancel request	FE00	None
Success	Matching is complete - No final Identifier is supplied	0000	None
Pending	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys	FF00	Identifier
	Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this identifier	FF01	Identifier

7.1.2.2 Real-World Activity – Move SCU

7.1.2.2.1 Associated Real-World Activity – Move SCU (Import)

When selecting a data entry in the Query UI and activate the "Import" function, a retrieval request is passed to the DICOM application which issues a C-MOVE service according to the Patient Root or Study Root query model. (The Storage Service Class Conformance Statement describes the C-STORE service, which is generated by processing the C-MOVE service.)

The transferred image data are processed as described in the storage class SCP descriptions.

The possibility to request the remote C-MOVE provider (remote application that responded to the C-FIND) to move data to an application entity other that the C-MOVE SCU (the AXIOM Artis DICOM application) is NOT USED.

7.1.2.2.2 Proposed Presentation Contexts - Move SCU

The Siemens AXIOM Artis DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCU	None
Study Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian Explicit VR Big Endian Explicit VR Little Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.2 1.2.840.10008.1.2.1	SCU	None

7.1.2.2.3 SOP Specific Conformance Statement - Move SCU

At association establishment time the C-MOVE presentation context shall be negotiated. The C-STORE sub-operations must be done on a different association to transfer images to the own Storage Service Class SCP.

The Move SCU interprets following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources - Unable to calculate number of matches	A701	(0000,0902)
	Out of Resources - Unable to perform sub operations	A702	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	Cxxx	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	Sub-operations Complete - One or more Failures of Warnings	B000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Success	Sub-operations Complete - No Failures or Warning	0000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

7.1.3 Association Acceptance Policy

The Siemens AXIOM Artis DICOM application will accept associations for the following DIMSE-C operations as SCP:

- C-FIND
- C-GET
- C-MOVE
- C-FIND-CANCEL

Extended negotiation - which is relational retrieve - is NOT supported for the above listed services. The AXIOM Artis DICOM application does support multiple C-FIND requests over the same association, while multiple C-MOVE or C-GET operations are NOT supported over the same association.

7.1.3.1 Real-World Activity - Find SCP

7.1.3.1.1 Associated Real-World Activity – Accept Find request to SCP

The associated Real-World activity is to respond query requests to an SCU with the query model Patient Root, Study Root and Patient/Study Only. Relational retrieve operation is NOT supported. With a C-FIND-CANCEL request the running query can be canceled at any time.

Multiple C-FIND requests over the same association are supported.

7.1.3.1.2 Accepted Presentation Contexts - Find SCP

The Siemens AXIOM Artis DICOM application will accept Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Study Root Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Patient/Study Only Query/Retrieve Model – FIND	1.2.840.10008.5.1.4.1.2.3.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

7.1.3.1.3 SOP Specific Conformance Statement - Find SCP

The Siemens AXIOM Artis DICOM Query/Retrieve SCP supports hierarchical queries with all mandatory and optional search keys. The following table describes the search keys for the four levels of query that the SCP supports.

Attribute Name	Tag	Usage SCU	Matching
Patient Level			
Patient Name	(0010,0010)	R	Single value, Wildcard, universal
Patient ID	(0010,0020)	U (Patient Root, Patient/Study Only) R (Study Root)	Single Value, Wildcard, universal
Patient's Birth Date	(0010,0030)	O	Single Value, Range, universal
Patient's Birth Time	(0010,0032)	O	Single Value, Range, universal
Patient's Sex	(0010,0040)	O	Single Value, Wildcard, universal
Ethnic Group	(0010,2160)	O	Single Value, Wildcard, universal
Patient Comments	(0010,4000)	O	universal
Study Level			
Study Instance UID	(0020,000D)	U	Single Value, List of UID
Study ID	(0020,0010)	R	Single Value, Wildcard, universal
Study Date	(0008,0020)	R	Single Value, Range, universal
Study Time	(0008,0030)	R	Single Value, Range, universal
Accession Number	(0008,0050)	R	Single Value, Wildcard, universal
Referring Physician's Name	(0008,0090)	O	Single Value, Wildcard, universal
Study Description	(0008,1030)	O	Single Value, Wildcard, universal
Admitting Diagnosis Description	(0008,1080)	O	Single Value, Wildcard, universal
Patient's Age	(0010,1010)	O	Single Value, Wildcard, universal
Patient's Size	(0010,1020)	O	Single Value, universal
Patient's Weight	(0010,1030)	O	Single Value, universal
Occupation	(0010,2180)	O	Single Value, Wildcard, universal
Additional Patient History	(0010,21B0)	O	universal
Series Level			
Series Instance UID	(0020,000E)	U	Single Value, List of UID

Attribute Name	Tag	Usage SCU	Matching
Series Number	(0020,0011)	R	Single Value, Wildcard, universal
Modality	(0008,0060)	R	Single Value, Wildcard, universal
Laterality	(0020,0060)	O	Single Value, Wildcard, universal
Referenced Study Component Sequence	(0008,1111)	O	universal
Body Part Examined	(0018,0015)	O	Single Value, Wildcard, universal
Patient Position	(0018,5100)	O	Single Value, Wildcard, universal
Smallest Pixel Value in Series	(0028,0108)	O	Single Value, universal
Largest Pixel Value in Series	(0028,0109)	O	Single Value, universal
Protocol Name	(0018,1030)	O	Single Value, Wildcard, universal
Series Date	(0008,0021)	O	Single Value, Range, universal
Series Time	(0008,0031)	O	Single Value, Range, universal
Series Description	(0008,103E)	O	Single Value, Wildcard, universal
Image Level			
SOP Instance UID	(0008,0018)	U	Single Value, List of UID
Image Number	(0020,0013)	R	Single Value, universal
Image Date	(0008,0023)	O	Single Value, Range, universal
Image Time	(0008,0033)	O	Single Value, Range, universal

The query attributes contents will be treated case-sensitive.

With wildcard queries the symbol "?" is treated as "*" by the C-FIND SCP application. As a consequence the query string of "?abc*" will be processed as "*abc*".

Usage of Storage Media File-Set ID, Retrieve AE Title with C_FIND_RSP message:

- The Storage Media File-Set ID - if existent - can be returned at Study/Series/Image Level.
- The Retrieve AE Title - if existent - can only be returned at Image Level (for Patient Root and Study Root models) or Study Level (for Patient/Study Only model).

The Find SCP returns following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources	A700	(0000,0902)
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	C001	(0000,0901) (0000,0902)
Cancel	Matching terminated due to Cancel request	FE00	None
Success	Matching is complete - No final Identifier is supplied	0000	None
Pending	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys	FF00	Identifier
	Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this identifier	FF01	Identifier

7.1.3.2 Real-World Activity - Get SCP

7.1.3.2.1 Associated Real-World Activity – Accept Get request to SCP

The associated Real-World activity is to respond to retrieve requests initiated from a foreign SCU. The SCP supports the query model Patient Root, Study Root and Patient/Study Only. The Storage Service Class Conformance Statement describes the C-STORE service, which is generated by the C-GET service. Relational retrieve operation is NOT supported.

Multiple C-GET requests over the same association are NOT supported.

7.1.3.2.2 Accepted Presentation Contexts - Get SCP

The Siemens AXIOM Artis DICOM application will accept Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Model – GET	1.2.840.10008.5.1.4.1.2.1.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Study Root Query/Retrieve Model – GET	1.2.840.10008.5.1.4.1.2.2.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Patient/Study Only Query/Retrieve Model – GET	1.2.840.10008.5.1.4.1.2.3.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

7.1.3.2.3 SOP Specific Conformance Statement - Get SCP

At association establishment time the C-GET presentation context must be negotiated along with the C-STORE sub-operations which must be accomplished on the same association as the C-GET operation. Relational retrieve operation is NOT supported.

The Get SCP returns following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources - Unable to calculate number of matches	A701	(0000,0902)
	Out of Resources - Unable to perform sub operations	A702	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	C001	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	Sub-operations Complete - One or more Failures of Warnings	B000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

Service Status	Meaning	Error Codes	Related Fields
Success	Sub-operations Complete - No Failures or Warning	0000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

7.1.3.3 Real-World Activity - Move SCP

7.1.3.3.1 Associated Real-World Activity – Accept Move request to SCP

The associated Real-World activity is to respond to retrieve requests to an SCU. The SCP supports the query model Patient Root, Study Root and Patient/Study Only. The Storage Service Class Conformance Statement describes the C-STORE service, which is generated by the C-MOVE service. Relational retrieve operation is NOT supported.

Multiple C-MOVE requests over the same association are NOT supported.

7.1.3.3.2 Accepted Presentation Contexts - Move SCP

The Siemens AXIOM Artis DICOM application will accept Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Patient Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Study Root Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None
Patient/Study Only Query/Retrieve Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

7.1.3.3.3 SOP Specific Conformance Statement - Move SCP

At association establishment time the C-MOVE presentation context shall be negotiated. The C-STORE sub-operations is done on a different association, specified in the C-MOVE request, to transfer images to a remote SCP of the Storage Service Class. Relational retrieve operation is NOT supported.

The Move SCP returns following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources - Unable to calculate number of matches	A701	(0000,0902)
	Out of Resources - Unable to perform sub operations	A702	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	C001	(0000,0901) (0000,0902)
Cancel	Sub-operations terminated due to Cancel Indication	FE00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Warning	Sub-operations Complete - One or more Failures of Warnings	B000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Success	Sub-operations Complete - No Failures or Warning	0000	(0000,1020) (0000,1021) (0000,1022) (0000,1023)
Pending	Sub-operations are continuing	FF00	(0000,1020) (0000,1021) (0000,1022) (0000,1023)

8 Implementation Model Print

The Print Management Service Classes define an application-level class of services, which facilitate the printing of images on a hardcopy medium. The print management SCU and print management SCP are peer DICOM print management application entities. The AXIOM Artis DICOM print application supports the print management DIMSE services to act as SCU.

8.1 Application Data Flow Diagram

The AXIOM Artis DICOM network implementation is a Windows NT application and acts as SCU for the print management network service.

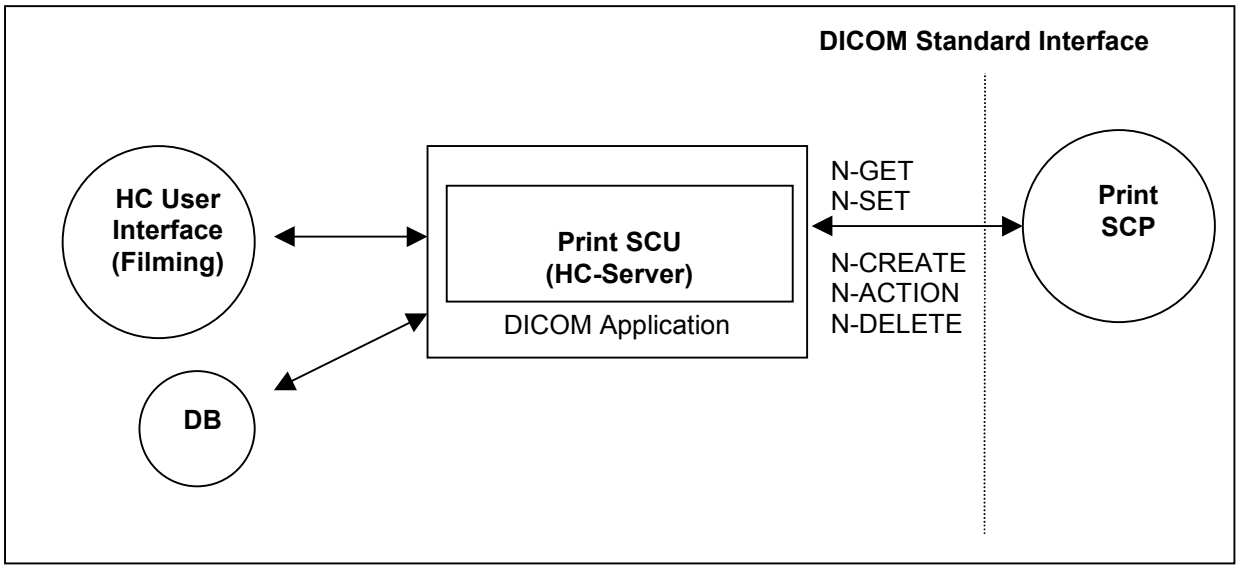


Figure 5: AXIOM Artis DICOM Application Data Flow Diagram – Print SCU

8.2 Functional Definition of Application Entities

The Print SCU is invoked by the user interface to setup film-sheet layout and whenever an image is ready to be printed on film. The Print SCU will hold and maintain all data needed to compile a complete film-sheet from the data (images, layout, configuration) received. Whenever a film-sheet is ready to print the related data is used to supply the Information to the SOP Classes of the Print Management Service Class. A queue is maintained, in order to intermediately store several film-sheets in case of resource problems on printer. The SCU will only supply and require the mandatory SOP Classes of the Print Management Service Class.

8.3 Sequencing of Real-World Activities

Not applicable

9 Application Entity Specification Print

9.1 Print Management AE Specification

The AXIOM Artis print management SCU (HCS) invokes print management DIMSE services to transfer images from the local AE to the remote SCP AE to print images with defined layout on a selected network-based DICOM hardcopy printer. This is done in an "full-page" print mode.

SIEMENS AXIOM Artis DICOM products provide Standard Conformance to the following DICOM V3.0 Print Management Meta SOP Classes as an SCU:

SOP Class Name	SOP Class UID
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
- Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
- Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
- Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4
- Printer SOP Class	1.2.840.10008.5.1.1.16
Print Job SOP Class	1.2.840.10008.5.1.1.14

9.1.1 Association Establishment Policies

9.1.1.1 General

Whenever a film is completely set up and printed by command or automatism the job is prepared for processing. As soon as the queue is ready to process the job is activated and processed according the processing data. The related Print application will initiate an association to the print destination and process the printing of the related information. The association will be closed, if there is no further film to print within a fixed time-frame (1 min.). With no current association open, the Print manager will perform a cyclic check of the camera status (5 min. interval).

The default PDU size used will be 28 KB.

9.1.1.2 Number of Associations

The Siemens AXIOM Artis DICOM application initiates one association at a time for each different print device configured.

9.1.1.3 Asynchronous Nature

The Siemens AXIOM Artis DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

9.1.1.4 Implementation Identifying Information

Implementation Class UID	1.2.12.2.1107.5.5.9.990801
Implementation Version Name	“SIEMENS_SWFVA47W"

9.1.2 Association Initiation Policy

Triggered by the Print job queue the Print Management SCU establishes an association by using the DICOM association services. With the help of the N-GET request for the Printer SOP Class the Status is determined before printing.

If no problem is encountered, then with the N-CREATE/N-SET Services for the related Basic Print SOP Classes the film sheet is set up for printing and the image(s) is(are) transferred to the printer device.

After the last film is printed from queue, the Print application will leave open the association for another 60 seconds. If a new film job is ready for printing within this time-limit, the job will be immediately processed over the still open association. If there is no new job, the association is closed if the time-out elapsed. This is done to optimize automated printing.

During the "idle-time" (no open association to printer), the Print application will issue a cyclic camera status request (using N-GET of Printer SOP Class) every 5 minutes.

9.1.2.1 Associated Real-World Activity - Print

9.1.2.1.1 Associated Real-World Activity - Printing a Printer Job Queue Entry

Whenever the user prepares a film-sheet, it is forwarded to the Printer Job queue. As soon as the associated Printer device is available the job is activated and association is set up.

The film sheet is internally processed, converted to a Standard/1-1 page and then the page image is sent. Status is controlled by awaiting any N-EVENT message all through the transfer until the last image or film-sheet is sent.

If the response from the remote application contains a status other than Success or Warning the association is aborted.

9.1.2.1.2 Proposed Presentation Contexts

The Siemens AXIOM Artis DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Basic Grayscale Print Management Meta SOP class	1.2.840.10008.5.1.1.9	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

Basic film session SOP class	1.2.840.10008.5.1.1.1	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Basic Film Box SOP class	1.2.840.10008.5.1.1.2	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Basic Grayscale Image Box SOP class	1.2.840.10008.5.1.1.4	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Printer SOP class	1.2.840.10008.5.1.1.16	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None
Print Job SOP class	1.2.840.10008.5.1.1.14	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

9.1.2.1.3 SOP specific Conformance Statement – Meta SOP Classes

The Siemens AXIOM Artis DICOM print management SCU conforms to the DICOM Basic Grayscale Print Management Meta SOP Class.

The application uses a setting platform to define the properties of the connected DICOM SCP, e.g.:

- maximum number of print jobs in the queue
- maximum number of print copies
- supported film sizes of the connected DICOM SCP
- supported film formats of the DICOM SCP
- lookup-table definition.

The printing is only suspended in the case of a failure return status of the SCP.

9.1.2.1.3.1 Basic Film Session SOP class

The Basic Film Session information object definition describes all the user-defined parameter which are common for all the films of a film session. The Basic Film Session refers to one or more Basic Film Boxes and that are printed on one hardcopy printer.

The AXIOM Artis DICOM print management SCU supports the following DIMSE Service elements for the Basic Film Session SOP Class as SCU:

- N-CREATE
- N-DELETE

The Basic Film Session SOP Class N-CREATE-RQ (SCU) uses the following attributes:

Attribute Name	Tag	Usage SCU	Supported Values
Number of Copies	(2000,0010)	U	
Medium Type	(2000,0030)	U	BLUE FILM CLEAR FILM PAPER
Film Destination	(2000,0040)	U	MAGAZINE PROCESSOR

The affected SOP Instance UID received with N-CREATE-RSP message will be kept internally and used for later requests (e.g. N-DELETE-RQ) on the Basic Film Session - see below:

Attribute Name	Tag	Source of Information
Requested SOP Instance UID	(0000,1000) → (0000,1001)	Affected SOP Instance UID of N-CREATE-RSP on Basic Film Session

The N-DELETE-RQ on the Basic Film Session SOP Class is used to remove the complete Basic Film Session SOP Instance hierarchy.

The Basic Film Session SOP class interprets the following status codes (from N-CREATE-RSP, N-DELETE-RSP messages):

Service Status	Meaning	Error Codes
Failure	Film session SOP instances hierarchy does not contain film box SOP instances	C600
	Unable to create print job, print queue is full	C601
	Image size is larger than images box size	C603
Warning	Memory allocation not supported	B600
	Film session printing is not supported	B601
	Film box does not contain image box (empty page)	B602
Success	Film belonging to the film session are accepted for printing	0000

9.1.2.1.3.2 Basic Film Box SOP class

The Basic Film Box information object definition describes all the user-defined parameter of one film of the film session. The Basic Film Box information description defines the presentation parameters, which are common for all images on a given sheet of film.

The Basic Film Box refers to one or more Image Boxes.

Supported Service Elements as SCU are:

- N-CREATE
- N-ACTION
- N-DELETE

The Basic Film Box SOP class N-CREATE-RQ message uses the following attributes (the actual values for each attribute depend on DICOM printer configuration within the AXIOM Artis DICOM print management SCU):

Attribute Name	Tag	Usage SCU	Supported Values
Image Display Format	(2010,0010)	M	STANDARD\1,1
Referenced Film Session Sequence	(2010,0500)	M	
> Referenced SOP Class UID	(0008,1150)	M	1.2.840.10008.5.1.1.1
> Referenced SOP Instance UID	(0008,1155)	M	
Film Orientation	(2010,0040)	M	PORTRAIT
Film Size ID	(2010,0050)	M	8INX10IN, 10INX12IN, 10INX14IN, 11INX14IN,, 14INX14IN, 14INX17IN, 24CMX24CM, 24CMX30CM
Magnification Type	(2010,0060)	M	BILINEAR, CUBIC, NONE, REPLICATE

Max Density	(2010,0130)	U	
Min Density	(2010,0120)	U	

The N-CREATE-RSP message from the Print SCP includes the Referenced Image Box Sequence with SOP Class/Instance UID pairs which will be kept internally to be further used for the subsequent Basic Image Box SOP Class N-SET-RQ messages.

When all Image Boxes (including parameters) for the film-sheet have been set, the AXIOM Artis DICOM print manager will issue a N-ACTION-RQ message with the SOP Instance UID of the Basic Film Box and the Action Type ID of 1.

The affected SOP Instance UID received with N-CREATE-RSP message will be kept internally and used for later requests (e.g. N-DELETE-RQ) on the Basic Film Box - see below:

Attribute Name	Tag	Source of Information
Requested SOP Instance UID	(0000,1000) → (0000,1001)	Affected SOP Instance UID of N-CREATE-RSP on Basic Film Box

The Basic Film Box SOP class interprets the following status codes:

Service Status	Meaning	Error Codes
Failure	Unable to create print job, print queue is full	C602
	Image size is larger than images box size	C603
Warning	Film box does not contain image box (empty page)	B603
	Requested MinDensity or MaxDensity outside of Printer's operating range	B605
Success	Film accepted for printing	0000

9.1.2.1.3.3 Basic Grayscale Image Box SOP Class

The Basic Grayscale Image Box information object definition is the presentation of an image and image related data in the image area of a film. The Basic Image Box information describes the presentation parameters and image pixel data, which apply to a single image of a sheet of film.

The Grayscale Image Box SOP Class uses only the N-SET-RQ with the following attributes:

Attribute Name	Tag	Usage SCU	Supported Values
Image Position	(2020,0010)	M	1
BASIC Grayscale Image Sequence	(2020,0110)	M	
> Samples per Pixel	(0028,0002)	M	1
> Photometric Interpretation	(0028,0004)	M	MONOCHROME2
> Rows	(0028,0010)	M	
> Columns	(0028,0011)	M	
> Pixel Aspect Ratio	(0028,0034)	M	
> Bits Allocated	(0028,0100)	M	8
> Bits Stored	(0028,0101)	M	8
> High Bit	(0028,0102)	M	7
> Pixel Representation	(0028,0103)	M	0
> Pixel Data	(7FE0,0010)	M	

The Grayscale Image Box SOP class interpret the following status codes:

Service Status	Meaning	Error Codes
Failure	Image contains more pixel than printer can print in Image Box	C603
	Insufficient memory in printer to store the image	C605

Service Status	Meaning	Error Codes
Warning	Requested MinDensity or MaxDensity outside of Printer's operating range	B605
Success		0000

9.1.2.1.3.4 Printer SOP Class

The Printer SOP Class is the possibility to monitor the status of the hardcopy printer in a synchronous and an asynchronous way.

The SCU uses the mandatory N-EVENT Report DIMSE service to monitor the changes of the printer status in an asynchronous way.

It can directly ask the Printer (SCP) for its status or receive Events from the Printer asynchronously:

- N-GET as SCU
- N-EVENT-REPORT as SCU

In both cases the following information is supported:

Used Printer N-EVENT Report attributes

Event-type Name	Event	Attributes	Tag	Usage SCU
Normal	1			
Warning	2	Printer Status Info	(2110,0020)	U
Failure	3	Printer Status Info	(2110,0020)	U

Mandatory Printer N-GET-RSP, N-EVENT-REPORT-RQ attributes

Attribute Name	Tag	Usage SCP	Supported Values
Printer Status	(2110,0010)	M	NORMAL, FAILURE, WARNING
Printer Status Info	(2110,0020)	M	SUPPLY EMPTY[a], SUPPLY LOW, RECEIVER FULL, NO RECEIVE MGZ, FILM JAM

9.1.2.1.3.5 Print Job SOP Class

The optional Print Job SOP Class is the possibility to monitor the execution of the print process.

The AXIOM Artis DICOM Print Management application supports the mandatory N-EVENT-REPORT DIMSE Service of this optional class to receive the changes of the Print Job Status in an asynchronous way.

It can receive Events from the Print SCP asynchronously:

- N-EVENT-REPORT

The following information is supported:

Used Print Job N-EVENT Report attributes

Event-type Name	Event	Attributes	Tag	Usage SCU
Normal	1	Execution Status Info	(2100,0030)	U
		Print Job ID	(2100,0010)	-- (Print Queue Management SOP Class not supported)
		Film Session Label	(2000,0050)	U

[a] Only valid in case of Printer Status WARNING

Event-type Name	Event	Attributes	Tag	Usage SCU
		Printer Name	(2110,0030)	U
Printing	2	Execution Status Info	(2100,0030)	U
		Print Job ID	(2100,0010)	-- (Print Queue Management SOP Class not supported)
		Film Session Label	(2000,0050)	U
		Printer Name	(2110,0030)	U
Done	3	Execution Status Info	(2100,0030)	U
		Print Job ID	(2100,0010)	-- (Print Queue Management SOP Class not supported)
		Film Session Label	(2000,0050)	U
		Printer Name	(2110,0030)	U
Failure	4	Execution Status Info	(2100,0030)	U
		Print Job ID	(2100,0010)	-- (Print Queue Management SOP Class not supported)
		Film Session Label	(2000,0050)	U
		Printer Name	(2110,0030)	U

9.1.3 Association Acceptance Policy

Not applicable

10 Implementation Model Worklist

The Basic Worklist Management Service class defines an application-level class of service, which facilitates the transfer of worklists from the information system to the imaging modality. The worklist is queried by the AE and supplies the SCU with the scheduled tasks, which have to be performed on the modality. The AXIOM Artis DICOM worklist application supports the worklist service as SCU.

10.1 Application Data Flow Diagram

The AXIOM Artis DICOM network implementation is a Windows NT application and acts as SCU for the Basic Worklist Service using the Modality Worklist SOP Class.

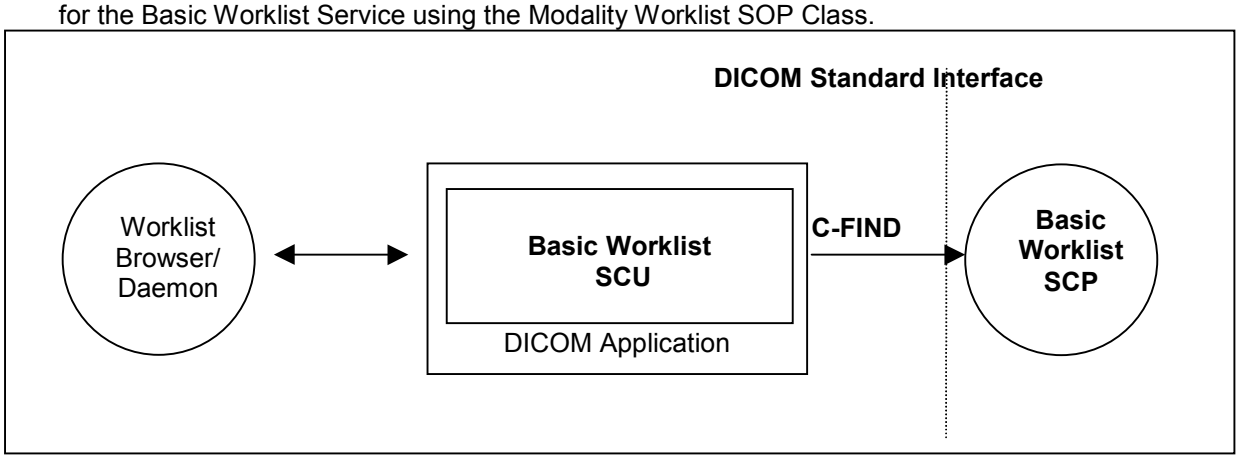


Figure 6: AXIOM Artis Application Flow Diagram – Basic Worklist SCU

Note: It is configurable to get the worklist updates either automatically (in a configurable time interval) or manually (initiated by the user).

10.2 Functional Definitions of Application Entities

The worklist SCU is invoked from the patient registration user interface or by timer to request the worklist from an remote Information System (Modality Worklist Class SCP) to perform a match to the worklist query keys specified in the C-Find DIMSE service issued for the Modality Worklist Model.

The worklist SCP responses to the C-FIND query and scheduled imaging service requests (scheduled procedure steps) and patient demographic information will be downloaded from the information system to the AXIOM Artis modality. All information retrieved will be hold in the scheduling database for usage during Patient Registration procedure.

10.3 Sequencing of Real-World Activities

Not applicable

11 Application Entity Specification Worklist

11.1 Modality Worklist Service AE Specification

The Modality worklist SCU (patient registration in conjunction with the network application) requests that the remote SCP performs a match of all keys specified in the query against the information in its worklist database.

The SIEMENS AXIOM Artis DICOM network implementation is a Windows NT application and acts as SCU for the Basic Worklist Service using the Modality Worklist SOP Class:

SOP Class Name	SOP Class UID
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31

11.1.1 Association Establishment Policies

11.1.1.1 General

There will be a cyclic update of the modality scheduler database by background worklist request with date/time and modality information.

In addition the user can request worklist update with "Update Worklist". The modality will not insert duplicate entries identified by unique identifiers.

The user can set up the System online to “query by own AET” or “query for Modality”.

The default PDU size used will be 28 KB.

11.1.1.2 Number of Associations

The Siemens AXIOM Artis DICOM application initiates one association at a time to query worklist entry data.

11.1.1.3 Asynchronous Nature

The Siemens AXIOM Artis DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

11.1.1.4 Implementation Identifying Information

Implementation Class UID	1.2.12.2.1107.5.5.9.990801
Implementation Version Name	“SIEMENS_SWFVA47W"

11.1.2 Association Initiation Policy

The network application will cyclically query the worklist and by request of patient registration interface. Ever then it establishes an association by using the DICOM association services. During association establishment the negotiation of SOP classes to exchange the capabilities of the SCU and the SCP is not supported.

The following DIMSE-C operation is supported as SCU:

- C-FIND

11.1.2.1 Real-World Activity

11.1.2.1.1 Associated Real-World Activity - Query (Update) Worklist

A network application will perform worklist queries with the C-FIND request at regular intervals. In addition it can be triggered by immediate request. The received worklist items will be compared with the contents of the local scheduler database. New items will be inserted into scheduler database.

11.1.2.1.2 Proposed Presentation Contexts

The Siemens AXIOM Artis DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Modality Worklist Information Model- FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCU	None

11.1.2.1.3 SOP Specific Conformance Statement

Search Key Attributes of the Worklist C-FIND

The Siemens AXIOM Artis DICOM worklist SCU supports worklist queries with all required search keys. The following tables describe the search keys that the SCU supports.

Attribute Name	Tag	Matching Key Type	Query Value
Scheduled Procedure Step Sequence	(0040,0100)	R	
>Scheduled Station AE Title	(0040,0001)	R	<own AET> or <empty>[a]
>Scheduled Procedure Step Start Date	(0040,0002)	R	<act. Date>-<act. Date>
>Scheduled Procedure Step Start Time	(0040,0003)	R	000000-235959
>Modality	(0008,0060)	R	own
>Scheduled Performing Physician's Name	(0040,0006)	R	NULL
Patient's Name	(0010,0010)	R	NULL
Patient ID	(0010,0020)	R	NULL

[a] This depends on user configuration (Options->Configuration->Patient Registration) if the "own AET" is provided or not. Use the "Search" tabcard and (un-)check the "Worklist for Local/Modality" item.

Return Key Attributes of the Worklist C-FIND

The Siemens AXIOM Artis DICOM worklist SCU supports worklist queries with return key attributes of all types. The following tables describe the return keys that the SCU supports.

An "x" in the **UI** column will indicate the attribute is visualized when browsing the Worklist results and/or during Patient Registration.

An "x" in the **IOD** column will indicate that the related attribute is included into the SOP Instances of the IOD's created during processing of this worklist request.

Attribute Name	Tag	Return Key Type	UI	IOD
SOP Common				
Specific Character Set	(0008,0005)	1C		x
Scheduled Procedure Step				
Scheduled Procedure Step Sequence	(0040,0100)	1		
>Scheduled Station AE Title	(0040,0001)	1	x	
>Scheduled Procedure Step Start Date	(0040,0002)	1	x	
>Scheduled Procedure Step Start Time	(0040,0003)	1	x	
>Scheduled Procedure Step End Date	(0040,0004)	3	-	
>Scheduled Procedure Step End Time	(0040,0005)	3	-	
>Modality	(0008,0060)	1	-	x
>Scheduled Performing Physician's Name	(0040,0006)	1	x	x[a]
>Scheduled Procedure Step Description	(0040,0007)	1C	-	
>Scheduled Station Name	(0040,0010)	2	-	
>Scheduled Procedure Step Location	(0040,0011)	2	-	
>Scheduled Action Item Code Sequence	(0040,0008)	1C	-	
>>Code Value	(0008,0100)	1C	-	
>>Coding Scheme Designator	(0008,0102)	1C	-	
>>Code Meaning	(0008,0104)	3	-	
>Pre-Medication	(0040,0012)	2C	-	
>Scheduled Procedure Step ID	(0040,0009)	1	-	x
>Requested Contrast Agent	(0032,1070)	2C	-	x
>Comments on the Scheduled Procedure Step	(0040,0400)	3	-	
Requested Procedure				
Requested Procedure ID	(0040,1001)	1	x	x
Requested Procedure Description	(0032,1060)	1C	-	x
Requested Procedure Code Sequence	(0032,1064)	1C	-	
>Code Value	(0008,0100)	1C	-	
>Coding Scheme Designator	(0008,0102)	1C	-	
>Code Meaning	(0008,0104)	3	-	
Study Instance UID	(0020,000D)	1	-	x
Referenced Study Sequence	(0008,1110)	2	-	
>Referenced SOP Class UID	(0008,1150)	1C	-	
>Referenced SOP Instance UID	(0008,1155)	1C	-	
Requested Procedure Priority	(0040,1003)	2	-	
Patient Transport Arrangements	(0040,1004)	2	-	
Reason for the Requested Procedure	(0040,1002)	3	-	
Placer Order Number / Procedure	(0040,1006)	3	-	
Filler Order Number / Procedure	(0040,1007)	3	-	
Confidentiality Code	(0040,1008)	3	-	
Reporting Priority	(0040,1009)	3	-	
Names of intended Recipients of Results	(0040,1010)	3	-	
Requested Procedure Comments	(0040,1400)	3	-	

[a] "Scheduled Performing Physician's Name" is taken as default for "Performing Physicians's Name"

Attribute Name	Tag	Return Key Type	UI	IOD
Requested Procedure Location	(0040,1005)	3	-	
Imaging Service Request				
Accession Number	(0008,0050)	2	x	x
Requesting Physician	(0032,1032)	2	-	x
Referring Physician's Name	(0008,0090)	2	x	x
Reason for Imaging Service Request	(0040,2001)	3	-	
Imaging Service Request Comments	(0040,2400)	3	-	
Requesting Service	(0032,1033)	3	-	
Issuing Date of Imaging Service Request	(0040,2004)	3	-	
Issuing Time of Imaging Service Request	(0040,2005)	3	-	
Placer Order Number / Imaging Service Request	(0040,2006)	3	-	
Filler Order Number / Imaging Service Request	(0040,2007)	3	-	
Order entered by ...	(0040,2008)	3	-	
Order Enterer's location	(0040,2009)	3	-	
Order Callback Number	(0040,2010)	3	-	
Visit Identification				
Admission ID	(0038,0010)	2	-	
Visit Status				
Current Patient Location	(0038,0300)	2	-	
Patient's Institution Residence	(0038,0400)	3	x	
Visit Relationship				
Referenced Patient Sequence	(0008,1120)	2	-	
>Referenced SOP Class UID	(0008,1150)	1C	-	
>Referenced SOP Instance UID	(0008,1155)	1C	-	
Patient Identification				
Patient's Name	(0010,0010)	1	x	x
Patient ID	(0010,0020)	1	x	x
Patient Demographic				
Patient's Birth Date	(0010,0030)	2	x	x
Patient's Sex	(0010,0040)	2	x	x
Patient's Weight	(0010,1030)	2	x	x
Confidential constraint on patient data	(0040,3001)	2	-	x
Patient Medical				
Patient State	(0038,0500)	2	-	x
Pregnancy Status	(0010,21C0)	2	x	x
Medical Alerts	(0010,2000)	2	x	x
Contrast Allergies	(0010,2110)	2	x	x
Special Needs	(0038,0050)	2	-	x

Status Codes of the Worklist C-FIND

The worklist SCU interprets following status codes:

Service Status	Meaning	Error Codes	Related Fields
Refused	Out of Resources	A700	(0000,0902)
Failed	Identifier does not match SOP Class	A900	(0000,0901) (0000,0902)
	Unable to process	Cxxx	(0000,0901) (0000,0902)
Cancel	Matching terminated due to Cancel request	FE00	None
Success	Matching is complete - No final Identifier is supplied	0000	None
Pending	Matches are continuing - Current Match is supplied and any Optional Keys were supported in the same manner as Required Keys	FF00	Identifier

	Matches are continuing - Warning that one or more Optional Keys were not supported for existence and/or matching for this identifier	FF01	Identifier

12 Communication Profiles

12.1 Supported Communication Stacks

The Siemens AXIOM Artis DICOM application provides DICOM TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

12.1.1 TCP/IP Stack

The Siemens AXIOM Artis DICOM application uses the TCP/IP stack from the Windows NT system upon which it executes. It uses the MergeCOM-3 subroutine library from Merge Technologies Inc. that is based on a Berkeley socket interface.

12.1.1.1 API

The Siemens AXIOM Artis DICOM application uses the MergeCOM library that is based on a TCP/IP socket interface.

12.1.1.2 Physical Media Support

The Siemens AXIOM Artis DICOM application is indifferent to the physical medium over which TCP/IP executes; it inherits this from the Windows NT system upon which it executes.

13 Extensions / Specializations / Privatizations

13.1.1 Standard Extended / Specialized / Private SOPs

Please refer to Appendix A for all information on these topics. A detailed overview is given there.

13.1.2 Private Transfer Syntaxes

Not applicable

14 Configuration

14.1 AE Title/Presentation Address Mapping

To ensure unique identification within the network the hostname should be used as part of the AE Titles (see examples below, hostname = Artisca1). The string can be up to 16 characters long and must not contain any extended characters, only 7-bit ASCII characters (excluding Control Characters) are allowed according to DICOM Standard.

14.1.1 DICOM Verification

The Verification Service uses the AE configuration of the DICOM Service that is checked with the C-ECHO message. e.g. Verification will use the Storage AE, if initiated to check the configuration of a remote DICOM node.

14.1.2 DICOM Storage AE Title

The DICOM Storage application provides the application entity title, which can be configured via Service UI:

e.g. STU_ArtisCA1

The port number is set to the fixed value of

104

14.1.3 DICOM Query/Retrieve AE Title

The DICOM Query/Retrieve application uses the same application entity title as the DICOM Storage AE.

14.1.4 DICOM Print AE Title

The DICOM Print application provides the application entity title:

e.g. PRI_ArtisCA1

The port number is set to the fixed value of

108

14.1.5 DICOM Modality Worklist AE Title

The DICOM Modality Worklist application provides the application entity title:

e.g. HRI_ArtisCA1

14.2 Configurable Parameters

The Application Entity Titles, host names and port numbers are configured using the Siemens AXIOM Artis Service/Installation Tool. For each AET the list of services supported can be configured.

14.2.1 Storage and Query/Retrieve

The Siemens AXIOM Artis Service/Installation Tool can be used to set the AET's, port-numbers, host-names, IP-addresses and capabilities for the remote nodes (SCP's). The user can select transfer syntaxes, compression modes and query models for each SCP separately.

For sending from the Viewer, it an be configured, if the "Send 512 to ..." function shall be used by default:

- *Send 512 Card Images*: enabled / disabled (Default: enabled)
- *Send 512 Other Images*: enabled / disabled (Default: enabled)

14.2.2 Print

The Siemens AXIOM Artis Service/Installation Tool can be used to configure the SCP (DICOM-Printer). The AET, host-name, IP-address and port-number can be set.

14.2.3 Worklist

The Siemens AXIOM Artis Service/Installation Tool can be used to configure the SCP (Worklist Provider). The AET, host-name, IP-address, port-number and time-outs can be set.

Additional configurable parameters for Basic Worklist Service are:

- *Query Waiting Time* - the time to wait for the C-FIND-RSP after sending the C-FIND-RQ (default 20s)
- *Max Query Match Number* – the maximum number of entries accepted as worklist response (default is 100)
- *Query Interval* - the time between two cyclic C-FIND-RQ to the HIS (default is 60 min)

14.3 Default Parameters

This installation tool also uses some default parameters:

- max PDU size set to 28672 Bytes (28 kB)
- time-out for accepting/rejecting an association request: 240 s
- time-out for responding to an association open/close request: 240 s
- time-out for accepting a message over network: 240 s
- time-out for waiting for data between TCP/IP-packets: 240 s

The time-outs for waiting for a Service Request/Response message from the remote node are as follows:

- for Storage SCP/SCU: 600 s
- for Query/Retrieve SCP/SCU: 600 s
- for Basic Worklist SCU; configurable, see section 14.2
- for Print Management SCU:
  - time-out for Response to N-SET-RQ: 240 s
  - time-out for Response to other Requests: 60 s

15 Support of Extended Character Sets

The Siemens AXIOM Artis DICOM application supports the ISO 8859 Latin 1 (ISO-IR 100) character set.

Also the Japanese language character sets JIS X 0201 (ISO-IR 13 Japanese katakana and ISO-IR 14 Japanese romaji), JIS X 0208 (ISO-IR 87 Japanese kanji) and JIS X 0212 (IOS-IR 159 Supplementary Japanese kanji) are supported.

M.A.S. Offline Media Application Profile

1 Class and Profile Identification

This document defines an Application Profile Class for Universal X-Ray Modular Angiographic / Radiographic applications.

The identifier for this class shall be PRI-XAMAS. This class is intended to be used for interchange of extended and private Information Objects via CD-R or re-writeable magneto-optical disk (MOD) offline media between dedicated Angiography, Neuro-Radiology, Radiography applications build from a common architecture.

The specific application profiles in this class are shown in Table 1:

Application Profile	Identifier	Description
Universal X-Ray Modular Angio/ Radio System on CD-R	PRI-XAMAS-CD	Handles interchange of Composite SOP Instances and privately defined SOP Instances (Dose Reports, Object Graphics, Quantification Results and more).
Universal X-Ray Modular Angio/ Radio System on 2.3 GB MOD	PRI-XAMAS-MOD23	Handles interchange of Composite SOP Instances and privately defined SOP Instances (Dose Reports, Object Graphics, Quantification Results and more).
Universal X-Ray Modular Angio/ Radio System on 4.1 GB MOD[a]	PRI-XAMAS-MOD41	Handles interchange of Composite SOP Instances and privately defined SOP Instances (Dose Reports, Object Graphics, Quantification Results and more).

Equipment claiming conformance for this Universal X-Ray Modular Angio/Radio System shall make a clear statement on handling of the private defined SOP Instances.

2 Clinical Context

This application profile facilitates the interchange of X-Ray acquisition and derived images and private data related to them. Typical media interchange would be from in-lab acquisition equipment to dedicated angio workstations and archive systems with specific extensions to handle the private data objects (in both directions).

Additionally, images (from MR, CT, US) used to prepare interventional procedures, multi-modality images (e.g. integrated US) and images derived from primary X-Ray images, such as annotations, quantitative analysis images, reference images, screen capture images may be interchanged via this profile.

2.1 Roles and Service Class Options

This Application Profile uses the Media Storage Service Class defined in PS 3.4 with the Interchange Option.

The Application Entity shall support one or more of the roles of File Set Creator (FSC), File Set Reader (FSR), and File Set Updater (FSU), defined in PS 3.10.

[a] Definition of this profile is based on DICOM Part12 changes introduced by accepted Supplement 44.

2.1.1 File Set Creator

The Application Entity acting as a File-Set Creator generates a File Set under the PRI-XAMAS-CD Application Profile.

File Set Creators shall be able to generate the Basic Directory SOP Class in the DICOMDIR file with all the subsidiary Directory Records related to the

Image SOP Classes and Private SOP Classes stored in the File Set.

In case of the PRI-XAMAS-CD profile, the FSC shall offer the ability to either finalize the disc at the completion of the most recent write session (no additional information can be subsequently added to the disc) or to allow multi-session (additional information may be subsequently added to the disc).

Note

A multiple volume (a logical volume that can cross multiple physical media) is not supported by this Application Profile Class. If a set of Files, e.g., a Study, cannot be written entirely on one CD-R, the FSC will create multiple independent DICOM File-Set such that each File-Set can reside on a single CD-R medium controlled by its individual DICOMDIR file. The user of the FSC can opt to use written labels on the discs to reflect that there is more than one disc for this set of files (e.g., a Study).

2.1.2 File Set Reader

The role of the File Set Reader shall be used by Application Entities which receive the transferred File Set.

File Set Readers shall be able to read all the defined SOP Instances files defined for the specific Application Profiles to which a conformance claim is made, using all the defined Transfer Syntaxes.

2.1.3 File Set Updater

The role of the File Set Updater shall be used by Application Entities, which receive a transferred File Set and update it by the addition of processed information.

File Set Updaters shall be able to read and update the DICOMDIR file. File-Set Updaters do not have to read the image/private information objects. File-Set Updaters shall be able to generate any of the SOP Instances files defined for the specific Application Profiles to which a conformance claim is made, and to read and update the DICOMDIR file.

In case of the PRI-XAMAS-CD profile, the FSU shall offer the ability to either finalize a disc at the completion of the most recent write session (no additional information can be subsequently added to the disc) or to allow multi-session (additional information may be subsequently added to the disc).

Note (for CD-R)

If the disc has not been finalized, the File-Set Updater will be able to update information assuming there is enough space on the disc to write a new DICOMDIR file, the information, and the fundamental CD-R control structures. CD-R control structures are the structures that inherent to the CD-R standards; see PS 3.12

3 PRI-XAMAS Profiles

3.1 SOP Classes and transfer Syntaxes

These Application Profiles are based on the Media Storage Service Class with the Interchange Option.

Information Object Definition	SOP Class UID	Transfer Syntax UID	FSC	FSR	FSU
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	M
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	M	M	O
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	O	M	O
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	M	M	O
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	O	M	O
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
X-Ray Radiofluoroscopic Image	1.2.840.10008.5.1.4.1.1.12.2	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
CR Image	1.2.840.10008.5.1.4.1.1.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
CR Image	1.2.840.10008.5.1.4.1.1.1	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
CR Image	1.2.840.10008.5.1.4.1.1.1	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
CR Image	1.2.840.10008.5.1.4.1.1.1	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
CT image	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
CT Image	1.2.840.10008.5.1.4.1.1.2	JPEG Lossless Process 14 (selection value 1)	O	M	O

Information Object Definition	SOP Class UID	Transfer Syntax UID	FSC	FSR	FSU
		1.2.840.10008.1.2.4.70			
CT Image	1.2.840.10008.5.1.4.1.1.2	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
CT Image	1.2.840.10008.5.1.4.1.1.2	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
MR Image	1.2.840.10008.5.1.4.1.1.4	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
MR Image	1.2.840.10008.5.1.4.1.1.4	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
MR Image	1.2.840.10008.5.1.4.1.1.4	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
MR Image	1.2.840.10008.5.1.4.1.1.4	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
Ultrasound Image	1.2.840.10008.5.1.4.1.1.6.1	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
Ultrasound Multi-frame Image	1.2.840.10008.5.1.4.1.1.3.1	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
NM Image	1.2.840.10008.5.1.4.1.1.20	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	M	M	O
NM Image	1.2.840.10008.5.1.4.1.1.20	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	O	M	O
NM Image	1.2.840.10008.5.1.4.1.1.20	Explicit VR Big Endian Uncompressed 1.2.840.10008.1.2.2	O	M	O
NM Image	1.2.840.10008.5.1.4.1.1.20	JPEG Lossy (baseline or extended) 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.51	O	O	O
CSA Non-Image	1.3.12.2.1107.5.9.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	O	M	O
Detached Patient Management	1.2.840.10008.3.1.2.1.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	O	see DCS	O

FSC, FSR, FSU – denote the requirements for those roles
O – Optional
M - Mandatory

3.2 Physical Media and Formats

The PRI-XAMAS-CD Profile requires the 120mm CD-R physical media with the ISO/IEC 9660 Media Format, as defined in PS3.12.

The PRI-XAMAS-MOD23 Profile requires the 130mm 2.3 GB R/W MOD physical medium with the PCDOS Media Format, as defined in PS3.12.

The PRI-XAMAS-MOD41 Profile requires the 130mm 4.1 GB R/W MOD physical medium with the PCDOS Media Format, as proposed by pending DICOM CP 195.

3.3 Directory Information in DICOMDIR

Conforming Application Entities shall include in the DICOMDIR File the Basic Directory IOD containing Directory Records at the Patient and subsidiary levels appropriate to the SOP Classes in the File-set. All DICOM files in the File-set incorporating SOP Instances defined for the specific Application profile, shall be referenced by Directory Records.

Note

DICOMDIRs with no directory information are not allowed by this Application Profile

Privately defined IODs will be referenced by "PRIVATE" Directory Records.

3.3.1 Basic Directory IOD Specialization

This Application Profile makes use of optional attributes of the Basic Directory IOD to support recognition of Patient's Storage Service request results in spanning multiple volumes (file sets). Therefore the File Set Descriptor File can be used and is then referenced by optional Basic Directory IOD attributes. If existent, the specified Descriptor File may be used by FSR applications. Any FSU, FSC shall make a clear Statement if the Descriptor File mechanism is used according to the specialization defined in this Application Profile.

The Descriptor Files shall have the following contents:

One single Line without any control-characters and according to the Basic Character-Set having the following defined text:

"MULTIVOLUME: xx of yy"

xx, yy are replaced by the actual Number of the volume (xx) and the Total Number of Volumes in the set (yy).

If used, the Descriptor File shall have the File ID "README" and reside in same directory level as the DICOMDIR. It is referenced by the attribute [0004,1141] File-set Descriptor File ID having the defined content of "README".

3.3.2 Additional Keys

File-set Creators and Updaters are required to generate the mandatory elements specified in PS 3.3, Annex F of the DICOM Standard. Table 3:PRI-XAMAS-CD Additional DICOMDIR Keys specifies the additional associated keys. At each directory record level other additional data elements can be added, but it is not required that File Set Readers be able to use them as keys. Refer to the Basic Directory IOD in PS 3.3.

Key Attribute	Tag	Directory Record Level	Type	Notes
Date of Birth	(0010,0030)	PATIENT	2C	required, if present in SOP Instance
Patient´s Sex	(0010,0040)	PATIENT	2C	required, if present in SOP Instance
Series Date	(0008,0021)	SERIES	3	
Series Time	(0008,0031)	SERIES	3	
Institute Name	(0008,0080)	SERIES	2C	required, if present in SOP Instance
Institution Address	(0008,0081)	SERIES	2C	required, if present in SOP Instance
Series Description	(0008,103E)	SERIES	3	
Performing Physician´s Name	(0008,1050)	SERIES	2C	required, if present in SOP Instance
Image Type	(0008,0008)	IMAGE	1C	required, if present in SOP Instance
SOP Class UID	(0008,0016)	IMAGE	3	
SOP Instance UID	(0008,0018)	IMAGE	3	
Image Date	(0008,0023)	IMAGE	3	
Image Time	(0008,0033)	IMAGE	3	
Referenced Image Sequence	(0008,1140)	IMAGE	1C	required, if present in SOP Instance
> Referenced SOP Class UID	(0008,1150)			
> Referenced SOP Instance UID	(0008,1155)			
Image Position (Patient)	(0020,0032)	IMAGE	2C	required, if present in SOP Instance
Image Orientation (Patient)	(0020,0037)	IMAGE	2C	required, if present in SOP Instance
Frame of Reference UID	(0020,0052)	IMAGE	2C	required, if present in SOP Instance
Rows	(0028,0010)	IMAGE	3	
Columns	(0028,0011)	IMAGE	3	
Pixel Spacing	(0028,0030)	IMAGE	1C	required, if present in SOP Instance
Calibration Image	(0050,0004)	IMAGE	2C	required, if present in SOP Instance
Icon Image Sequence	(0088,0200)	IMAGE	3	Required for XA SOP Class
> Samples per Pixel	(0028,0002)			1
> Photometric Interpretation	(0028,0004)			MONOCHROME2
> Rows	(0028,0010)			128 for XA, 64 for others
> Columns	(0028,0011)			128 for XA, 64 for others
> Bits Allocated	(0028,0100)			8
> Bits Stored	(0028,0101)			8
> High Bit	(0028,0102)			7
> Pixel Representation	(0028,0103)			0
> Pixel Data	(7FE0,0010)			Icon Image

3.3.3 Private Directory Record Keys

Private Directory Records are supported by this Application Profile Class at the following Level - IMAGE. The PRIVATE Directory Records will have required elements in addition to the mandatory elements specified in PS 3.3.

The following table will list the additional required keys for PRIVATE Directory Records:

Key Attribute	Tag	Directory Record Level	Type	Notes
Private Record UID	(0004,1432)	PRIVATE	1	See Conformance Statement
SOP Class UID	(0008,0016)	PRIVATE	1C	required, if present in SOP Instance
SOP Instance UID	(0008,0018)	PRIVATE	1C	required, if present in SOP Instance
Image Type	(0008,0008)	PRIVATE	3	
Acquisition Date	(0008,0022)	PRIVATE	3	
Acquisition Time	(0008,0032)	PRIVATE	3	
Acquisition Number	(0020,0012)	PRIVATE	3	

Key Attribute	Tag	Directory Record Level	Type	Notes
CSA Data Type	(0029,xx08)	PRIVATE	1	private owner code = SIEMENS CSA NON-IMAGE
CSA Data Version	(0029,xx09)	PRIVATE	3	private owner code = SIEMENS CSA NON-IMAGE

3.3.4 Icon Images

Directory Records of type SERIES or IMAGE may include Icon Images. The Icon Image pixel data shall be as specified in PS 3.3 "Icon Image Key Definition", and restricted such, that Bits Allocated (0028,0100) and Bits Stored (0028,0101) shall be equal 8, and Rows (0028,0010) and Columns (0028,0011) shall be equal to 128 for XA Images and 64 for all other Images. The Photometric Interpretation (0028,0004) shall always be restricted to "MONOCHROME2".

PRIVATE Directory Records will not contain Icon Image information.

3.4 Other Parameters

This section defines other parameters common to all specific Application Profiles in the PRI-XAMAS class which need to be specified in order to ensure interoperable media interchange.

3.4.1 Multi-Frame JPEG Format

The JPEG encoding of pixel data shall use Interchange Format (with table specification) for all frames.

3.4.2 Attribute Value Precedence

The values of attributes contained in a Detached Patient Management SOP Instance referenced by a DICOMDIR PATIENT Directory Record shall take precedence over the values of those attributes contained in the SOP Instance referenced by a subsidiary Directory Record. The DICOMDIR Directory Records shall have key attribute values in accordance with this precedence.

Note

This allows patient identification and demographic information to be updated without changing the composite Image IOD files. The DICOMDIR file thus is critical in establishing the link between the updated information and the image. As an example, at the time an Image file was written, the patient's name therein was incorrect, or inconsistent with the Hospital Information System records. Subsequently, a Detached Patient Management file with the corrected name is added to the file-set. The FSR should use the name from the Patient File rather than in the Image File.

Application Profile Conformance Statement

This chapter will contain the Conformance Statement to all "Offline Media Application Profiles (incl. private extentions)" supported by the AXIOM Artis archive options.

Those application profiles supported shall be:

- Basic Cardiac
- 1024 Extended Cardiac
- General Purpose CDR
- M.A.S. private Application Profile

1 Introduction

1.1 Purpose

This DICOM Conformance Statement is written according to part PS 3.2 of [1].

The applications described in this conformance statement are the SIEMENS Angiographic/Radiographic Workstation (AXIOM Artis) based products using the AXIOM Artis software. The AXIOM Artis DICOM offline media storage service implementation acts as FSC, FSU and/or FSR for the specified application profiles and the related SOP Class instances.

1.2 Scope

This DICOM Conformance Statement refers to SIEMENS AXIOM Artis based products using AXIOM Artis software. The following table relates AXIOM Artis software names to SIEMENS products:

Software Name	SIEMENS AXIOM Artis Product
VA10C VA20F VA21C VA22x	AXIOM Artis

1.3 Definitions, Abbreviations

1.3.1 Definitions

DICOM Digital Imaging and Communications in Medicine
DIMSE DICOM Message Service Element
DIMSE-C DICOM Message Service Element with Composite information objects

1.3.2 Abbreviations

ACR American College of Radiology
AE DICOM Application Entity
ASCII American Standard Code for Information Interchange
AXIOM Artis AX-Workstation (for Angiographic/Radiographic viewing)
DB Database
DCS DICOM Conformance Statement
FSC File Set Creator
FSR File Set Reader
FSU File Set Updater
IOD DICOM Information Object Definition
ISO International Standard Organization
MOD Magneto-optical Disk
NEMA National Electrical Manufacturers Association
O Optional Key Attribute
PDU DICOM Protocol Data Unit
R Required Key Attribute
RWA Real-World Activity
U Unique Key Attribute

1.4 References

[1] Digital Imaging and Communications in Medicine (DICOM) 3.0, NEMA PS 3.1-12, 1999

1.5 Remarks

DICOM, by itself, does not guarantee interoperability. However, the Conformance Statement facilitates a first-level validation for interoperability between different applications supporting the same DICOM functionality as SCU and SCP, respectively.

This Conformance Statement is not intended to replace validation with other DICOM equipment to ensure proper exchange of information intended.

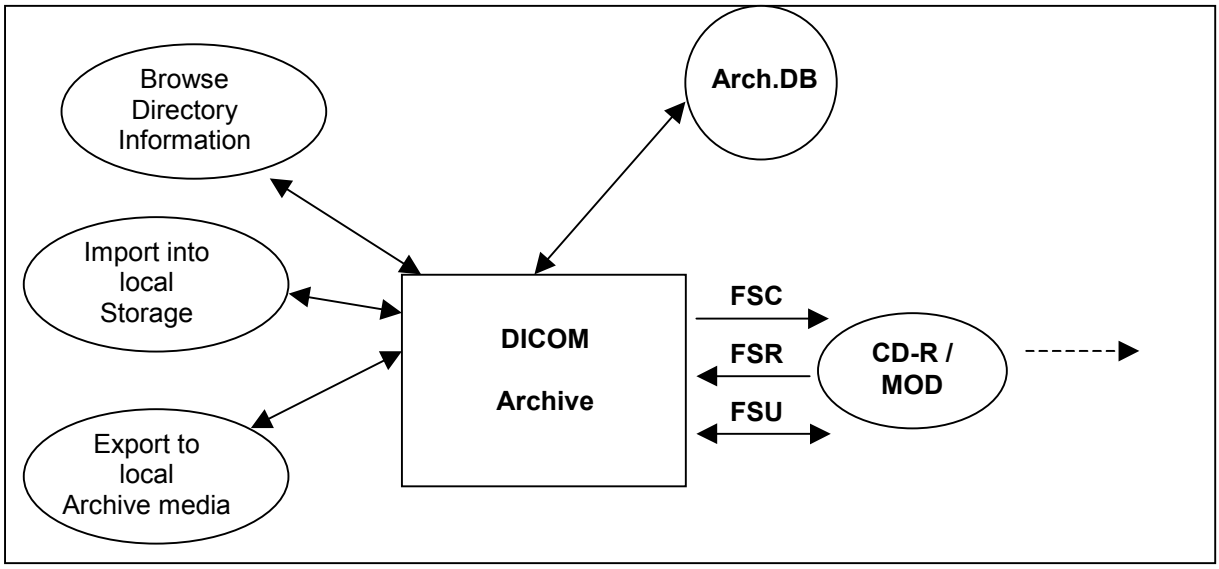
The scope of this Conformance Statement is to facilitate communication with Siemens and other vendors' Medical equipment. The Conformance Statement should be read and understood in conjunction with the DICOM 3.0 Standard [DICOM]. However, by itself it is not guaranteed to ensure the desired interoperability and a successful interconnectivity.

The user should be aware of the following important issues:

- The comparison of different conformance statements is the first step towards assessing interconnectivity between Siemens and non-Siemens equipment.
- Test procedures should be defined and tests should be performed by the user to validate the connectivity desired. DICOM itself and the conformance parts do not specify this.
- The standard will evolve to meet the users' future requirements. Siemens is actively involved in developing the standard further and therefore reserves the right to make changes to its products or to discontinue its delivery.
- Siemens reserves the right to modify the design and specifications contained herein without prior notice. Please contact your local Siemens representative for the most recent product information.

2 Implementation Model

2.1 Application Data Flow Diagram



The DICOM archive application will serve as an interface to the CD-R offline medium device. It serves interfaces to include the offline media directory into the browser and to copy SOP instances to a medium or retrieve SOP Instances from medium into local storage.

The DICOM Archive application will support the 120mm CD-R medium.

The FSU role will update new SOP Instances only to media with pre-existing File-sets conforming to the Application Profiles supported.

The contents of the DICOMDIR will be temporarily stored in Archive-Database.

2.2 Functional Definitions of AEs

The AXIOM Artis DICOM offline media storage application consists of the DICOM Archive application entity serving all interfaces to access offline media. The DICOM Archive application is capable of

1. creating a new File-set onto an unwritten medium (Export to…).
2. updating an existing File-set by writing new SOP Instances onto the medium (Export to...).
3. importing SOP Instances from the medium onto local storage
4. reading the File-sets DICOMDIR information into temporary database and pass it to display applications.

2.3 Sequencing of Real-World Activities

The DICOM Archive application will not perform updates before the Directory information of the DICOMDIR is completely read.

When performing updates, the SOP instances are checked for existence before updating. Duplicate instances will be avoided.

2.4 File Meta Information Options

Implementation Class UID	1.3.12.2.1107.5.9.990801
Implementation Version Name	"SIEMENS_SWFVA47W"

3 AE Specifications

3.1 DICOM Archive Specification

The DICOM Archive provides Standard conformance to Media Storage Service Class (Interchange Option). In addition Augmented conformance is provided to store extra data attributes important for the full feature support of the AXIOM Artis product SW. Details are listed in following Table:

Application Profiles Supported	Real-World Activity	Role	SC Option
PRI-XAMAS-CD AUG-XA1K-CD *1 STD-GEN-CD *2	Browse Directory Information	FSR	Interchange
	Import into local Storage	FSR	Interchange
	Export to local Archive Media	FSC, FSU	Interchange
STD-GEN-CD STD-XABC-CD STD-XA1K-CD	Browse Directory Information	FSR	Interchange
	Import into local Storage	FSR	Interchange

*1 – With no Private SOP Class used, the PRI-XAMAS-CD profile definitions are appropriate to describe the augmentation of the STD-XA1K-CD Profile.

*2 – With “Export 512 to…” or permanent configuration of this mode for the Viewer, the requirements to meet the STD-XABC-CD profile are met.

On AXIOM Artis based Systems, the Private Extended MAS Profile (PRI-XAMAS-CD) will be preferably used by the system. The General Purpose Interchange Profile (STD-GEN-CD), Basic Cardiac Profile (STD-XABC-CD) and 1024 X-Ray Angiographic Profile (STD-XA1K-CD) will be supported with read capability of the related media.

3.1.1 File Meta Information for the Application Entity

The Source Application Entity Title is set by configuration. See Chapter "Configuration" for details.

3.1.2 Real-World Activities for this Application Entity

3.1.2.1 Real-World Activity: Browse Directory Information

The DICOM Archive application acts as FSR using the interchange option when requested to read the media directory.

The DICOM archive application will read the DICOMDIR and insert those directory entries, that are valid for the application profiles supported, into a local database. The database can the then be used for browsing media contents.

Note

IconImageSQ is also supported in DICOMDIR. But only those Icon Images with BitsAllocated (0028,0100) equal to 8 and size of 64x64 or 128x128 pixels are imported into database and are visible in the Browser.

3.1.2.1.1 Application Profiles for the RWA: Browse Directory Information

See Table in section 3.1 for the Application Profiles listed that invoke this Application Entity for the Browse Directory Information RWA.

3.1.2.2 Real-World Activity: Import into local Storage

The DICOM Archive application acts as FSR using the interchange option when requested to read SOP Instances from the medium into the local storage.

The SOP Instance selected from the media directory will be copied into the local storage. Only SOP Instances, that are valid for the application profile supported and are listed as supported by the Storage SCP Conformance section (Network DCS, 5.1.3), can be retrieved from media storage. This is due to the fact that the Browse Directory Information will filter all SOP Instances not matching the Application profiles supported.

During operation no "Attribute Value Precedence" is applied to the SOP Instances. Detached Patient Management is not supported.

For media conforming to the STD-GEN-CD Profile the following SOP classes will be supported as an FSR:

Information Object Definition	SOP Class UID	Transfer Syntax UID
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1
CSA Non-Image	1.3.12.2.1107.5.9.1	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1

3.1.2.2.1 Application Profiles for the RWA: Import into local Storage

See Table in section 3.1 for the Application Profiles listed that invoke this Application Entity for the Import into Local Storage RWA.

3.1.2.3 Real-World Activity: Export to local Archive Media

The DICOM Archive application acts as FSU (for media with existing DICOM file-set) or FSC (media not initialized) using the interchange option when requested to copy SOP Instances from the local storage to local Archive Medium.

The DICOM Archive application will receive a list of SOP Instances to be copied to the local archive medium. According to the state of the medium inserted (new medium, Medium with DICOM file-set) the validity of the SOP Instances according to the applicable profile is checked. Only valid SOP Instances are accepted.

When the DICOM archive application is requested to copy SOP Instances the preferred application profile according configuration (AUG-XA1K-CD or PRI-XAMAS-CD) will be used to validate and copy the referred SOP Instances. When creating a new file-set no Descriptor File will be allocated and the related ID is not used.

The DICOM archive application will not close the medium.

With the "Export 512 to..." function of the Viewer or if configured as default transfer mode for the viewer, a copy of images in Cardiac Format (512x512, 8Bit) can be written onto medium. Please refer to the Storage section "Send 512 to..." RWA description to learn more about the type of conversion that is performed on the Instances.

3.1.2.3.1 Application Profiles for the RWA: Export to local Archive Media

See Table in section 3.1 for the Application Profiles listed that invoke this Application Entity for the Export to local Archive Media RWA.

4 Augmented and Private Profiles

4.1 Augmented Application Profiles

4.1.1 AUG-XA1K-CD

With no private Siemens Non-Images stored onto Medium, the definitions of the PRI-XAMAS-CD Profile are applicable to denote the augmentations for the STD-XA1K-CD Standard Profile.

Storage of Private Information Objects will only be supported with reference to a Private Application Profile (see next section).

4.2 Private Application Profiles

4.2.1 PRI-XAMAS-CD

The DICOM Archive application is conforming to the PRI-XAMAS application profile class provided in a separate document. Please refer to next section for more information on specializations and extentions in accordance to this Application Profile.

5 Extensions, Specializations and Privatizations of SOP Classes and Transfer Syntaxes

The SOP Classes listed refer in majority to those created by the equipment to which this conformance Statement is related to. For SOP classes not listed in this section, please refer to the Storage section of the DICOM Conformance Statement of the product. This will include all SOP Instances that can be received and displayed and therefor will be included into offline media storage even though these SOP Instances are not created by the equipment serving the Media Storage Service.

5.1 SOP Specific Conformance Statement for Basic Directory

5.1.1 Extension, Specialization for SIEMENS Non-Image Objects

According to the PRI-XAMAS Application Profile Class the usage of the Private Creator UIDs and further optional keys for the Directory Records referring to SIEMENS Non-Image Objects are listed in the following tables.

Attribute	Tag	Value used
Private Record UID	(0004,1432)	1.3.12.2.1107.5.9.1
SOP Class UID	(0008,0016)	1.3.12.2.1107.5.9.1

For those "Non-Images" no Icon Image Sequence will be generated.

6 Configuration

6.1 AE Title Mapping

6.1.1 DICOM Media Storage AE Title

The DICOM Storage application provides the application entity title:

CsaImageManager

7 Support of Extended Character Sets

The Siemens AXIOM Artis DICOM archive application supports the ISO 8859 Latin 1 (ISO-IR 100) character set.

Also the Japanese language character sets JIS X 0201 (ISO-IR 13 Japanese katakana and ISO-IR 14 Japanese romaji), JIS X 0208 (ISO-IR 87 Japanese kanji) and JIS X 0212 (IOS-IR 159 Supplementary Japanese kanji) are supported.

APPENDIX

A.1 SIEMENS Private Non-Image IOD

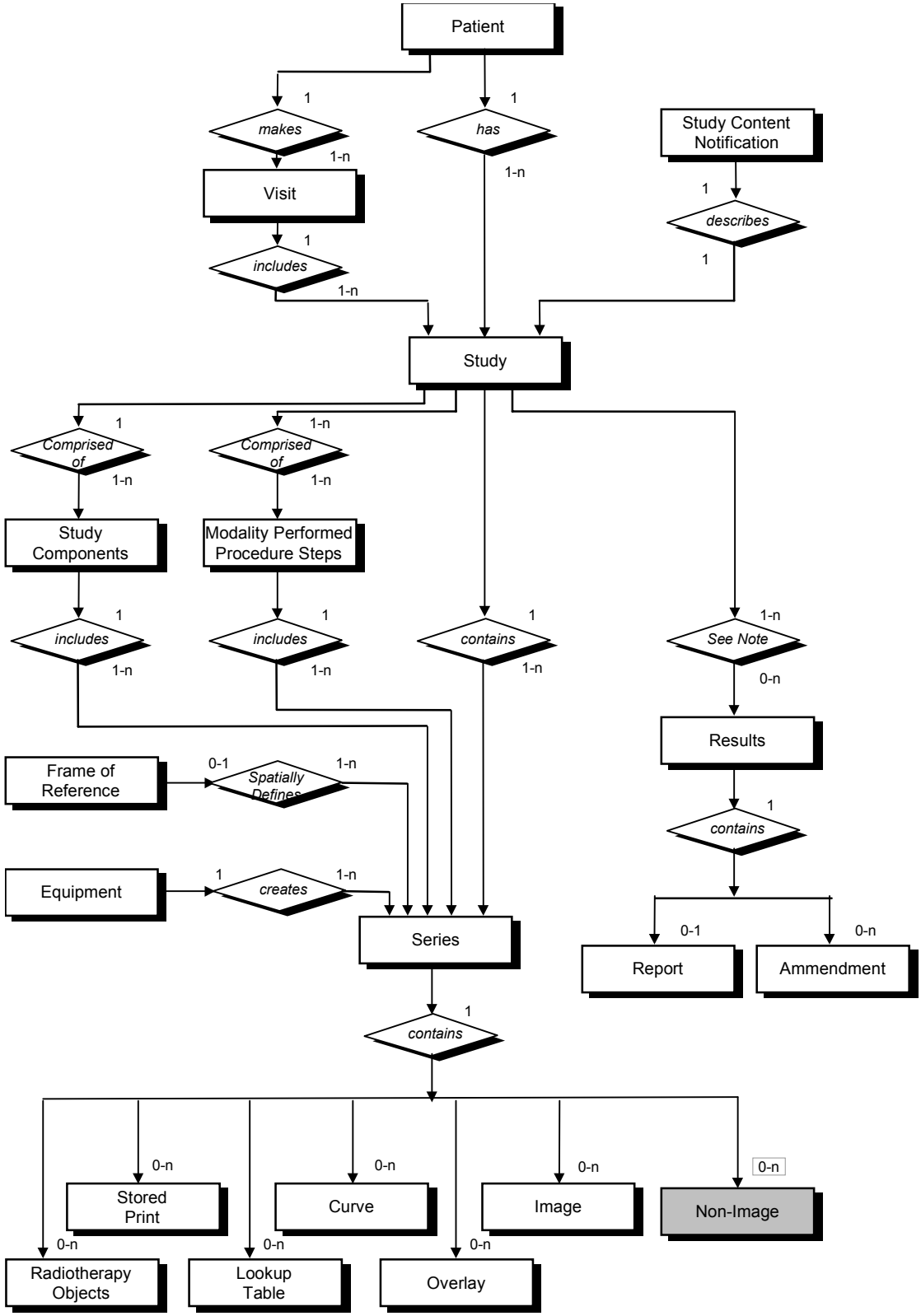
For encoding binary data-streams not representing image data, Siemens has created a private "Non-Image IOD" according to the rules governed by the DICOM Standard. The following section will roll-out the definition of this Private IOD. It can be communicated with Network Storage Service and Offline Media Storage Services.

The Siemens "Non-Image IOD" is identified by a private Non-Image Storage SOP Class UID of

"1.3.12.2.1107.5.9.1"

A.1.1 Siemens Non-Image IOD – E-R Model

The E-R model in A.1.2 depicts those components of the DICOM Information Model which directly refer to the Siemens Non-Image IOD. The Frame of Reference IE, Overlay IE, Modality Lookup-Table IE, VOI Lookup-Table IE and Curve IE are not components of the Siemens Non-Image IOD.


Patient
1
makes
1-n
Visit
1
includes
1-n
1
has
1-n
Study Content Notification
1
describes
1
Study
1
Comprised of
1-n
Study Components
1-n
Comprised of
1-n
Modality Performed Procedure Steps
1
includes
1-n
1
includes
1-n
1
contains
1-n
1-n
See Note
0-n
Results
1
contains
0-1
Report
0-n
Ammendment
Frame of Reference
0-1
Spatially Defines
1-n
Equipment
1
creates
1-n
Series
1
contains
0-n
Stored Print
0-n
Radiotherapy Objects
0-n
Curve
0-n
Lookup Table
0-n
Image
0-n
Overlay
0-n
Non-Image

A.1.2 Siemens Non-Image IOD - Module Table

IE	Module	Reference	Usage
Patient	Patient	[1] PS3.3 C.7.1.1	M
Study	General Study	[1] PS3.3 C.7.2.1	M
	Patient Study	[1] PS3.3 C.7.2.2	U
Series	General Series	[1] PS3.3 C.7.3.1	M
Equipment	General Equipment	[1] PS3.3 C.7.5.1	U
CSA	CSA Image Header	A.2.1	U
	CSA Series Header	A.2.2	U
	MEDCOM Header	A.2.3	U
	CSA Non-Image	A.1.3.1	M
	SOP Common	[1] PS3.3 C.12.1	M

A.1.3 Siemens Non-Image IOD - Modules

A.1.3.1 CSA Non-Image Module

The table in this section contains private IOD Attributes that describe CSA Non-Images.

Attribute Name	Tag	Owner	Type	Notes
Image Type	(0008,0008)	-	3	Image identification characteristics.
Acquisition Date	(0008,0022)	-	3	The date the acquisition of data that resulted in this data set started.
Acquisition Time	(0008,0023)	-	3	The time the acquisition of data that resulted in this data set started.
Derivation Description	(0008,2111)	-	3	A text description of how this data set was derived.
Acquisition Number	(0020,0012)	-	3	A number identifying the single continuous gathering of data over a period of time which resulted in this data set.
CSA Data Type	(0029,xx08)	SIEMENS CSA NON-IMAGE	1	CSA Data identification characteristics. Defined Terms: BSR REPORT = Study Report Data
CSA Data Version	(0029,xx09)	SIEMENS CSA NON-IMAGE	3	Version of CSA Data Info (0029,xx10) format and CSA Non-Image Data (7FE1,xx10) format.
CSA Data Info	(0029,xx10)	SIEMENS CSA NON-IMAGE	3	Information to describe the CSA Data (7FE1,xx10).
CSA Data	(7FE1,xx10)	SIEMENS CSA NON-IMAGE	2	Binary data as byte stream.

A.2 Siemens Standard Extended Modules

IE	Module	Reference	Usage	Note
Image	CSA Image Header	A.2.1	U	private GG information
	CSA Series Header	A.2.2	U	
	MEDCOM Header	A.2.3	U	private *syngo* information
	MEDCOM OOG	A.2.4	U	if object graphics is attached to image
	Edge Enhancement	A.2.5	U	private Filter Information
	Angio Viewing	A.2.6	U	private Viewing information
	Angio Acquisition	A.2.7	U	additional private information about image acquisition
	Angio Quantitation	A.2.8	U	if image is a Quant Report
	Original Image Info	A.2.9	U	If derived image

A.2.1 CSA Image Header Module

The table in this section contains private IOD Attributes that describe the CSA Image Header:

Attribute Name	Tag	Owner	Type	Notes
CSA Image Header Type	(0029,xx08)	SIEMENS CSA HEADER	1	CSA Image Header identification characteristics. Defined Terms: NUM 4 = NUMARIS/4 SOM 5 = SOMARIS/5
CSA Image Header Version	(0029,xx09)	SIEMENS CSA HEADER	3	Version of CSA Image Header Info (0029,xx10) format.
CSA Image Header Info	(0029,xx10)	SIEMENS CSA HEADER	3	Manufacturer model dependent information.

A.2.2 CSA Series Header Module

The table in this section contains private IOD Attributes that describe the CSA Series Header:

Attribute Name	Tag	Owner	Type	Notes
CSA Series Header Type	(0029,xx28)	SIEMENS CSA HEADER	1	CSA Series Header identification characteristics. Defined Terms: NUM 4 = NUMARIS/4
CSA Series Header Version	(0029,xx29)	SIEMENS CSA HEADER	3	Version of CSA Series Header Info (0029,xx10) format.
CSA Series Header Info	(0029,xx20)	SIEMENS CSA HEADER	3	Manufacturer model dependent information.

A.2.3 MEDCOM Header Module

The table in this section contains private IOD Attributes that describe MEDCOM Header:

Attribute Name	Tag	Owner	Type	Notes
MedCom Header Type	(0029,xx08)	SIEMENS MEDCOM HEADER	1C	MedCom Header identification characteristics. Defined Terms: MEDCOM 1 (Required if MedCom Header Info (0029,xx10) present.)
MedCom Header Version	(0029,xx09)	SIEMENS MEDCOM HEADER	2C	Version of MedCom Header Info (0029,xx10) format. (Required if MEDCOM Header Info

				(0029,xx10) present.)
MedCom Header Info	(0029,xx10)	SIEMENS MEDCOM HEADER	3	Manufacturer model dependent information. The value of the attribute MedCom Header Info (0029,xx10) can be build up in each user defined format.
MedCom History Information	(0029,xx20)	SIEMENS MEDCOM HEADER	3	MedCom defined Patient Registration history information. See A.1.3.1.
PMTF Information 1	(0029,xx31)	SIEMENS MEDCOM HEADER	3	Transformation Information
PMTF Information 2	(0029,xx32)	SIEMENS MEDCOM HEADER	3	Transformation Information
PMTF Information 3	(0029,xx33)	SIEMENS MEDCOM HEADER	3	Transformation Information
PMTF Information 4	(0029,xx34)	SIEMENS MEDCOM HEADER	3	Transformation Information

A.2.3.1 MEDCOM History Information

The value of the attribute MEDCOM History Information (0029,xx20) is defined in the following way:

Part	Name	Type	Bytes	Notes
header	Identifier	string	32	Always “CSA HISTORY”
	Version	string	32	e.g. “V1.10”
>n Items	Class Name	string	64	
	Modification String	string	1024	

A.2.4 MEDCOM OOG Module

The table in this section contains private IOD Attributes that describe MEDCOM Object Oriented Graphics (OOG).This module is used whenever object graphics is drawn on the image and need to be stored as graphic object properties. Given the condition that the module contents was not removed by other modalities, the graphic objects remain re-animatable if such an image was transferred and is then retrieved back.

Attribute Name	Tag	Owner	Type	Notes
CSA Series Header Type	(0029,xx28)	SIEMENS MEDCOM OOG	1	MEDCOM Object Oriented Graphics (OOG) identification characteristics. Defined Terms: MEDCOM OOG 1
CSA Series Header Version	(0029,xx29)	SIEMENS MEDCOM OOG	3	Version of MEDCOM OOG Info (0029,xx10) format.
CSA Series Header Info	(0029,xx20)	SIEMENS MEDCOM OOG	3	MEDCOM Object Oriented Graphics (OOG) data.

The graphics objects are also fully drawn in the Image Overlay Plane for compatibility with other products, which do not support the MedCom OOG module. Any system not supporting the MedCom OOG module shall remove the OOG module and it’s contents when modifying the image overlay plane content.

A.2.5 Edge Enhancement Module

Attribute Name	Tag	Owner	Type	Notes
Standard Edge Enhancement Sequence	(0029,xx00)	CARDIO-D.R. 1.0	3	Standard formula according Dynaview Extentions (one or more items possible)
>Convolution Kernel Size	(0029,xx01)	CARDIO-D.R. 1.0	1C	x-/y-size value pair. Each value shall be greater or

				equal to 3. Required if Sequence is present
>Convolution Kernel Coefficients	(0029,xx02)	CARDIO-D.R. 1.0	1C	Row-by-row list of the kernel Coefficients. Required if Sequence is present
>Edge Enhancement Gain	(0029,xx03)	CARDIO-D.R. 1.0	1C	Applied Filter gain Factor. Range is from 0 to 100 Percent. Required if Sequence is present

A.2.6 Angio Viewing Module

Attribute Name	Tag	Owner	Type	Notes
Review Mode	(0019,xx00)	SIEMENS SMS-AX VIEW 1.0	3	Special Modes for Angio Review. Defined Terms are 1 = REV_MAXFILL, 2 = REV_LOOP, 3 = REV_SCROLL, 4 = REV_STEREO_LOOP
Anatomical Background Percent	(0019,xx01)	SIEMENS SMS-AX VIEW 1.0	3	Percentage of Mix between Subtracted Image Result and Native Mask. Range is from 0 to 100.
Number of Phases	(0019,xx02)	SIEMENS SMS-AX VIEW 1.0	3	1-4 (1 or # of "Variable Frame Rate" acq phases)
Apply Anatomical Background	(0019,xx03)	SIEMENS SMS-AX VIEW 1.0	3	boolean
Pixel Shift Array	(0019,xx04)	SIEMENS SMS-AX VIEW 1.0	3	4 * Number of Frames (0028,0008)
Brightness	(0019,xx05)	SIEMENS SMS-AX VIEW 1.0	3	SUB windowing
Contrast	(0019,xx06)	SIEMENS SMS-AX VIEW 1.0	3	SUB windowing
Enabled Shutter	(0019,xx07)	SIEMENS SMS-AX VIEW 1.0	3	Visualize shutter
Native Edge Enhancement Percent Gain	(0019,xx08)	SIEMENS SMS-AX VIEW 1.0	3	Percent gain for native display of images.
Native Edge Enhancement LUT Index	(0019,xx09)	SIEMENS SMS-AX VIEW 1.0	3	
Native Edge Enhancement Kernel Size	(0019,xx0A)	SIEMENS SMS-AX VIEW 1.0	3	
Subtracted Edge Enhancement Percent Gain	(0019,xx0B)	SIEMENS SMS-AX VIEW 1.0	3	Percent gain for subtracted display of images.
Subtracted Edge Enhancement LUT Index	(0019,xx0C)	SIEMENS SMS-AX VIEW 1.0	3	
Subtracted Edge Enhancement Kernel Size	(0019,xx0D)	SIEMENS SMS-AX VIEW 1.0	3	
Fade Percent	(0019,xx0E)	SIEMENS SMS-AX VIEW 1.0	3	
Flipped before Laterality Applied	(0019,xx0F)	SIEMENS SMS-AX VIEW 1.0	3	
Apply Fade	(0019,xx10)	SIEMENS SMS-AX VIEW 1.0	3	
RefImages Taken	(0019,xx11)	SIEMENS SMS-AX VIEW 1.0	3	
Zoom	(0019,xx12)	SIEMENS SMS-AX VIEW 1.0	3	
Pan X	(0019,xx13)	SIEMENS SMS-AX VIEW 1.0	3	
Pan Y	(0019,xx14)	SIEMENS SMS-AX VIEW 1.0	3	
Native Edge Enhancement Adverse Percent Gain	(0019,xx15)	SIEMENS SMS-AX VIEW 1.0	3	
Subtracted Edge Enhancement Adverse Percent Gain	(0019,xx16)	SIEMENS SMS-AX VIEW 1.0	3	
Invert Flag	(0019,xx17)	SIEMENS SMS-AX	3	

		VIEW 1.0		
Quant 1K Overlay	(0019,xx1A)	SIEMENS SMS-AX VIEW 1.0	3	Only Store Monitor and Store Reference Images in QUANT (128 kByte)

A.2.7 Angio Acquisition Data Module

Attribute Name	Tag	Owner	Type	Notes
Acquisition Type	(0021,xx00)	SIEMENS SMS-AX ACQ 1.0	3	Technical Type of Acquisition performed to get image result. Defined Terms are 1 = fixed frame rate, 2 = variable frame rate (manually trigrd), 3 = varibale frame rate (time triggered), 4 = peri manual to head, 5 = peri slow speed to head, 6 = peri fast speed to head, 7 = peri manual to feet, 8 = peri slow speed to feet, 9 = peri fast speed to feet, 10 = dynavision manual inject., 11 = dynavision automatic, 12 = direct technique, 13 = continuous fluoro, 14 = pulsed fluoro, 15 = ECG triggered fluoro
Acquisition Mode	(0021,xx01)	SIEMENS SMS-AX ACQ 1.0	3	Technical Mode of Acquisition performed to get image result. Defined Terms are: 0 = no mode specified, 1 = Digital Radiographie, 2 = DSA, 3 = Peri-DSA, 4 = DR stepping, 5 = DR Dynavision (nat), 6 = Dynavision (sub), 7 = Card, 8 = Direct technique, 20 = Roadmap Fluoro, 21 = Normal Fluoro, 22 = Card Fluoro
Footswitch Index	(0021,xx02)	SIEMENS SMS-AX ACQ 1.0	3	
Acquisition Room	(0021,xx03)	SIEMENS SMS-AX ACQ 1.0	3	
Current Time Product	(0021,xx04)	SIEMENS SMS-AX ACQ 1.0	3	(uAs)
Dose	(0021,xx05)	SIEMENS SMS-AX ACQ 1.0	3	(uGy/pulse)
Skin Dose Percent	(0021,xx06)	SIEMENS SMS-AX ACQ 1.0	3	
Skin Dose Accumulation	(0021,xx07)	SIEMENS SMS-AX ACQ 1.0	3	(mGy)
Skin Dose Rate	(0021,xx08)	SIEMENS SMS-AX ACQ 1.0	3	(mGy/min)
Impac Filename	(0021,xx09)	SIEMENS SMS-AX ACQ 1.0	3	
Copper Filter	(0021,xx0A)	SIEMENS SMS-AX ACQ 1.0	3	(in 0.1 mm)
Measuring Field	(0021,xx0B)	SIEMENS SMS-AX ACQ 1.0	3	Decimal values are defined as follows: 1 = left 2 = middle (rectangular) 3 = left and middle 4 = right 5 = left and right 6 = right and middle 7 = left and right and middle

				8 = central (approx. round) 9 = left and central 12 = right and central 13 = left and right and central
Post Blanking Circle	(0021,xx0C)	SIEMENS SMS-AX ACQ 1.0	3	left edge, upper edge, radius
Total Steps	(0021,xx0E)	SIEMENS SMS-AX ACQ 1.0	3	Number of Images which make up a Peri or DR-Step acquisition
Dyna X-Ray Info	(0021,xx0F)	SIEMENS SMS-AX ACQ 1.0	3	Multiplicity of (3 * Number of Rames). (kV value, uA value, ms value) Only with Dyna Images
Modality LUT Input Gamma	(0021,xx10)	SIEMENS SMS-AX ACQ 1.0	3	
Modality LUT Output Gamma	(0021,xx11)	SIEMENS SMS-AX ACQ 1.0	3	
SH_STPAR	(0021,xx12)	SIEMENS SMS-AX ACQ 1.0	3	1st Byte = version. Technical data-structure with Gantry information.
Acquisition Zoom	(0021,xx13)	SIEMENS SMS-AX ACQ 1.0	3	0 = Off, 1 = On. Not to be mixed up with digital zoom from Viewing module.
Harmonization	(0021,xx15)	SIEMENS SMS-AX ACQ 1.0	3	
DR Single Flag	(0021,xx16)	SIEMENS SMS-AX ACQ 1.0	3	1 = DR SINGLE, else single Frame DR acquisition
Soruce to Isocenter	(0021,xx17)	SIEMENS SMS-AX ACQ 1.0	3	(mm)
Pressure Data	(0021,xx18)	SIEMENS SMS-AX ACQ 1.0	3	
ECG Index Array	(0021,xx19)	SIEMENS SMS-AX ACQ 1.0	3	
FD Flag	(0021,xx1A)	SIEMENS SMS-AX ACQ 1.0	3	
SH_ZOOM	(0021,xx1B)	SIEMENS SMS-AX ACQ 1.0	3	1st Byte = version. Technical data-structure with Gantry information.
SH_COLPAR	(0021,xx1C)	SIEMENS SMS-AX ACQ 1.0	3	1st Byte = version. Technical data-structure with Gantry information.

A.2.8 Angio Quantitation Module

Attribute Name	Tag	Owner	Type	Notes
Horizontal Calibration Pixel Size	(0023,xx00)	SIEMENS SMS-AX QUANT 1.0	3	(in mm)
Vertical Calibration Pixel Size	(0023,xx01)	SIEMENS SMS-AX QUANT 1.0	3	(in mm)
Calibration Object	(0023,xx02)	SIEMENS SMS-AX QUANT 1.0	3	
Calibration Object Size	(0023,xx03)	SIEMENS SMS-AX QUANT 1.0	3	
Calibration Method	(0023,xx04)	SIEMENS SMS-AX QUANT 1.0	3	
Filename	(0023,xx05)	SIEMENS SMS-AX QUANT 1.0	3	
Frame Number	(0023,xx06)	SIEMENS SMS-AX QUANT 1.0	3	
Calibration Factor Multiplicity	(0023,xx07)	SIEMENS SMS-AX QUANT 1.0	3	Multiplicity Horizontal followed by Multiplicity for Vertical

A.2.9 Original Image Info Module

Attribute Name	Tag	Owner	Type	Notes
View Native	(0025,xx00)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Original Series Number	(0025,xx01)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Original Image Number	(0025,xx02)	SIEMENS SMS-AX	3	

		ORIGINAL IMAGE INFO 1.0		
Win Center	(0025,xx03)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Win Width	(0025,xx04)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Win Brightness	(0025,xx05)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Win Contrast	(0025,xx06)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Original Frame Number	(0025,xx07)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Original Mask Frame Number	(0025,xx08)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Opac	(0025,xx09)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Original Number of Frames	(0025,xx0A)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Original Scene Duration	(0025,xx0B)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Identifier LOID	(0025,xx0C)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Original Scene VFR Info	(0025,xx0D)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Original Frame ECG Position	(0025,xx0E)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	
Original ECG 1st Frame Offset	(0025,xx0F)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	<retired, no longer used>
Zoom Flag	(0025,xx10)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0	3	

A.2.10 SOP Common Module – Image Type Extentions

Type of Scene/Image	Image Type
Single Plane Scene	ORIGINAL\PRIMARY\SINGLE PLANE\SINGLE A (or B)
Biplane Scene	ORIGINAL\PRIMARY\BIPLANE A (or B)
Reference Image	DERIVED\SECONDARY\SINGLE PLANE\SINGLE A(B)\REFIMAGE
Dynamic Reference Image (Dynamap)	DERIVED\SECONDARY\SINGLE PLANE\SINGLE A(B)\DYNAMAP
Store Monitor	DERIVED\SECONDARY\SINGLE PLANE\SINGLE A(B)\STORE MONITOR
PeriVision – Mask Phase	ORIGINAL\PRIMARY\SINGLE PLANE\PLANE A\PERI\MASK\n[a]
PeriVision – Fill Phase	ORIGINAL\PRIMARY\SINGLE PLANE\PLANE A\PERI\FILL\n[a]
DynaVision – Mask Phase	ORIGINAL\PRIMARY\SINGLE PLANE\PLANE A\DYNA\MASK
DynaVision – Fill Phase	ORIGINAL\PRIMARY\SINGLE PLANE\PLANE A\DYNA\FILL
DynaVision – Injection Phase	ORIGINAL\PRIMARY\SINGLE PLANE\PLANE A\DYNA\INJECTION
DynaVision – Washout Phase	ORIGINAL\PRIMARY\SINGLE PLANE\PLANE A\DYNA\WASHOUT
Store Fluoro Loop	DERIVED\PRIMARY\SINGLE PLANE\SINGLE A(or B)\STORE FLUORO
Store Biplan Fluoro Loop	DERIVED\PRIMARY\BIPLANE A(or B)\\STORE FLUORO
Quant Result Image	DERIVED\SECONDARY\<3rd to nth value from Original>\QUANT
Study Report (Non-Image Object)	ORIGINAL\PRIMARY\SINGLE PLANE\\STUDY REPORT

A.3 Registry of DICOM Data Elements

Tag	Private Owner Code	Name	VR	VM
(0019,xx00)	SIEMENS SMS-AX VIEW 1.0	Review Mode	US	1
(0019,xx01)	SIEMENS SMS-AX VIEW 1.0	Anatomical Background Percent	US	1
(0019,xx02)	SIEMENS SMS-AX VIEW 1.0	Number of Phases	US	1
(0019,xx03)	SIEMENS SMS-AX VIEW 1.0	Apply Anatomical Background	US	1

[a] the term "n" is replaced by the related Step Number where the Image was acquired. Step Numbers start with "1".

Tag	Private Owner Code	Name	VR	VM
(0019,xx04)	SIEMENS SMS-AX VIEW 1.0	Pixel Shift Array	SS	4-4n
(0019,xx05)	SIEMENS SMS-AX VIEW 1.0	Brightness	US	1
(0019,xx06)	SIEMENS SMS-AX VIEW 1.0	Contrast	US	1
(0019,xx07)	SIEMENS SMS-AX VIEW 1.0	Enabled Shutters	US	1
(0019,xx08)	SIEMENS SMS-AX VIEW 1.0	Native Edge Enh. Percent Gain	US	1
(0019,xx09)	SIEMENS SMS-AX VIEW 1.0	Native Edge Enh. LUT Index	SS	1
(0019,xx0A)	SIEMENS SMS-AX VIEW 1.0	Native Edge Enh. Kernel Size	SS	1
(0019,xx0B)	SIEMENS SMS-AX VIEW 1.0	Subtr. Edge Enh. Percent Gain	US	1
(0019,xx0C)	SIEMENS SMS-AX VIEW 1.0	Subtr. Edge Enh. LUT Index	SS	1
(0019,xx0D)	SIEMENS SMS-AX VIEW 1.0	Subtr. Edge Enh. Kernel Size	SS	1
(0019,xx0E)	SIEMENS SMS-AX VIEW 1.0	Fade Percent	US	1
(0019,xx0F)	SIEMENS SMS-AX VIEW 1.0	Flipped before Laterality Applied	US	1
(0019,xx10)	SIEMENS SMS-AX VIEW 1.0	Apply Fade	US	1
(0019,xx11)	SIEMENS SMS-AX VIEW 1.0	RefImages Taken	US	1
(0019,xx12)	SIEMENS SMS-AX VIEW 1.0	Zoom	US	1
(0019,xx13)	SIEMENS SMS-AX VIEW 1.0	Pan X	SS	1
(0019,xx14)	SIEMENS SMS-AX VIEW 1.0	Pan Y	SS	1
(0019,xx15)	SIEMENS SMS-AX VIEW 1.0	Native Edge Enh. Adv Percent Gain	SS	1
(0019,xx16)	SIEMENS SMS-AX VIEW 1.0	Subtr. Edge Enh. Adv Percent Gain	SS	1
(0019,xx16)	SIEMENS SMS-AX VIEW 1.0	Invert Flag	US	1
(0019,xx1A)	SIEMENS SMS-AX VIEW 1.0	Quant 1K Overlay	OB	1
(0021,xx00)	SIEMENS SMS-AX ACQ 1.0	Acquisition Type	US	1
(0021,xx01)	SIEMENS SMS-AX ACQ 1.0	Acquisition Mode	US	1
(0021,xx02)	SIEMENS SMS-AX ACQ 1.0	Footswitch Index	US	1
(0021,xx03)	SIEMENS SMS-AX ACQ 1.0	Acquisition Room	US	
(0021,xx04)	SIEMENS SMS-AX ACQ 1.0	Current Time Product	SL	1
(0021,xx05)	SIEMENS SMS-AX ACQ 1.0	Dose	SL	1
(0021,xx06)	SIEMENS SMS-AX ACQ 1.0	Skin Dose Percent	SL	1
(0021,xx07)	SIEMENS SMS-AX ACQ 1.0	Skin Dose Accumulation	SL	1
(0021,xx08)	SIEMENS SMS-AX ACQ 1.0	Skin Dose Rate	SL	1
(0021,xx09)	SIEMENS SMS-AX ACQ 1.0	Impac Filename	UL	1
(0021,xx0A)	SIEMENS SMS-AX ACQ 1.0	Copper Filter	UL	1
(0021,xx0B)	SIEMENS SMS-AX ACQ 1.0	Measuring Field	UL	1
(0021,xx0C)	SIEMENS SMS-AX ACQ 1.0	Post Blanking Circle	SS	3
(0021,xx0E)	SIEMENS SMS-AX ACQ 1.0	Total Steps	SS	1
(0021,xx0F)	SIEMENS SMS-AX ACQ 1.0	Dyna X-Ray Info	SL	3-3n
(0021,xx10)	SIEMENS SMS-AX ACQ 1.0	Modality LUT Input Gamma	US	1
(0021,xx11)	SIEMENS SMS-AX ACQ 1.0	Modality LUT Output Gamma	US	1
(0021,xx12)	SIEMENS SMS-AX ACQ 1.0	SH_STPAR	OB	1-n
(0021,xx13)	SIEMENS SMS-AX ACQ 1.0	Acquisition Zoom	US	1
(0021,xx15)	SIEMENS SMS-AX ACQ 1.0	Harmonization	US	1
(0021,xx16)	SIEMENS SMS-AX ACQ 1.0	DR Single Flag	US	1
(0021,xx17)	SIEMENS SMS-AX ACQ 1.0	Source to Isocenter	SL	11
(0021,xx18)	SIEMENS SMS-AX ACQ 1.0	Pressure Data	US	1-n
(0021,xx19)	SIEMENS SMS-AX ACQ 1.0	ECG Index Array	SL	1-n
(0021,xx1A)	SIEMENS SMS-AX ACQ 1.0	FD Flag	US	1
(0021,xx1B)	SIEMENS SMS-AX ACQ 1.0	SH_ZOOM	OB	1-n
(0021,xx1C)	SIEMENS SMS-AX ACQ 1.0	SH_COLPAR	OB	1-n
(0023,xx00)	SIEMENS SMS-AX QUANT 1.0	Horizontal Calibration Pixel Size	DS	2
(0023,xx01)	SIEMENS SMS-AX QUANT 1.0	Vertical Calibration Pixel Size	DS	2
(0023,xx02)	SIEMENS SMS-AX QUANT 1.0	Calibration Object	LO	1
(0023,xx03)	SIEMENS SMS-AX QUANT 1.0	Calibration Object Size	DS	1
(0023,xx04)	SIEMENS SMS-AX QUANT 1.0	Calibration Method	LO	1

Tag	Private Owner Code	Name	VR	VM
(0023,xx05)	SIEMENS SMS-AX QUANT 1.0	Filename	ST	1
(0023,xx06)	SIEMENS SMS-AX QUANT 1.0	Frame Number	IS	1
(0023,xx07)	SIEMENS SMS-AX QUANT 1.0	Calibration Factor Multiplicity	IS	2
(0025,xx00)	… ORIGINAL IMAGE INFO 1.0	View Native	US	1
(0025,xx01)	… ORIGINAL IMAGE INFO 1.0	Original Series Number	US	1
(0025,xx02)	… ORIGINAL IMAGE INFO 1.0	Original Image Number	US	1
(0025,xx03)	… ORIGINAL IMAGE INFO 1.0	Win Center	US	1
(0025,xx04)	… ORIGINAL IMAGE INFO 1.0	Win Width	US	1
(0025,xx05)	… ORIGINAL IMAGE INFO 1.0	Win Brightness	US	1
(0025,xx06)	… ORIGINAL IMAGE INFO 1.0	Win Contrast	US	1
(0025,xx07)	… ORIGINAL IMAGE INFO 1.0	Original Frame Number	US	1
(0025,xx08)	… ORIGINAL IMAGE INFO 1.0	Original Mask Frame Number	US	1
(0025,xx09)	… ORIGINAL IMAGE INFO 1.0	Opac	US	1
(0025,xx0A)	… ORIGINAL IMAGE INFO 1.0	Original Number of Frames	US	1
(0025,xx0B)	… ORIGINAL IMAGE INFO 1.0	Original Scene Duration	DS	1
(0025,xx0C)	… ORIGINAL IMAGE INFO 1.0	Identifier LOID	LO	1
(0025,xx0D)	… ORIGINAL IMAGE INFO 1.0	Original Scene VFR Info	SS	1-n
(0025,xx0E)	… ORIGINAL IMAGE INFO 1.0	Original Frame ECG Position	SS	1
(0025,xx10)	… ORIGINAL IMAGE INFO 1.0	Zoom Flag	SS	1
(0029,xx08)	SIEMENS CSA HEADER	CSA Image Header Type	CS	1
(0029,xx09)	SIEMENS CSA HEADER	CSA Image Header Version	LO	1
(0029,xx10)	SIEMENS CSA HEADER	CSA Image Header Info	OB	1
(0029,xx18)	SIEMENS CSA HEADER	CSA Series Header Type	CS	1
(0029,xx19)	SIEMENS CSA HEADER	CSA Series Header Version	LO	1
(0029,xx20)	SIEMENS CSA HEADER	CSA Series Header Info	OB	1
(0029,xx08)	SIEMENS CSA NON-IMAGE	CSA Data Type	CS	1
(0029,xx09)	SIEMENS CSA NON-IMAGE	CSA Data Version	LO	1
(0029,xx10)	SIEMENS CSA NON-IMAGE	CSA Data Info	OB	1
(0029,xx08)	SIEMENS MEDCOM HEADER	MedCom Header Type	CS	1
(0029,xx09)	SIEMENS MEDCOM HEADER	MedCom Header Version	LO	1
(0029,xx10)	SIEMENS MEDCOM HEADER	MedCom Header Info	OB	1
(0029,xx20)	SIEMENS MEDCOM HEADER	MedCom History Information	OB	1
(0029,xx31)	SIEMENS MEDCOM HEADER	PMTF Information 1	LO	1
(0029,xx32)	SIEMENS MEDCOM HEADER	PMTF Information 2	UL	1
(0029,xx33)	SIEMENS MEDCOM HEADER	PMTF Information 3	UL	1
(0029,xx34)	SIEMENS MEDCOM HEADER	PMTF Information 4	CS	1
(0029,xx08)	SIEMENS MEDCOM OOG	MedCom OOG Type	CS	1
(0029,xx09)	SIEMENS MEDCOM OOG	MedCom OOG Version	LO	1
(0029,xx10)	SIEMENS MEDCOM OOG	MedCom OOG Info	OB	1
(0029,xx00)	CARDIO-D.R. 1.0	Standard Edge Enhancement Sequence	SQ	1
(0029,xx01)	CARDIO-D.R. 1.0	Convolution Kernel Size	US	2
(0029,xx02)	CARDIO-D.R. 1.0	Convolution Kernel Coefficients	US	1-n
(0029,xx03)	CARDIO-D.R. 1.0	Edge Enhancement Gain	FL	1
(7FE1,xx10)	SIEMENS CSA NON-IMAGE	CSA Data	OB	1

Note: Please be informed that some of the Private Owner Codes contain double-spaces in the name definitions. The following terms (only double-spaces marked) are defined:

SIEMENS SMS-AX<spc><spc>VIEW 1.0
SIEMENS SMS-AX<spc><spc>ACQ 1.0
SIEMENS SMS-AX<spc><spc>QUANT 1.0
SIEMENS SMS-AX<spc><spc>ORIGINAL IMAGE INFO 1.0

All spaces not specially marked, are single spaces.

A.4 Extended XA IOD

The MAS system will create images during acquisition and with postprocessing applications. Those will be encoded as XA Standard Extended SOP Class. Images created during postprocessing will be marked as derived. Please see the following table for a complete overview of supplied Type 1/2/3 Standard and additional Private Attributes:

"*overview of supplied attributes – X-Ray Angiographic image (Original, Derived)"*

Attribute Name	Tag	Value
Specific Character Set	(0008,0005)	from Configuration
Image Type	(0008,0008)	see "A.2.9 SOP Common Module - Image Type Extentions"
SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.12.1
SOP Instance UID	(0008,0018)	
Study Date	(0008,0020)	<yyyymmdd>
Series Date	(0008,0021)	<yyyymmdd>
Acquisition Date	(0008,0022)	Original: same as Image Date, Derived: Date of Original Acquisition
Image Date	(0008,0023)	<yyyymmdd> (Date of Creation)
Study Time	(0008,0030)	<hhmmss>
Series Time	(0008,0031)	<hhmmss>
Acquisition Time	(0008,0032)	Original: Same as Image Time, Derived: Time or Original Acquisition
Image Time	(0008,0033)	<hhmmss> (Time of Creation)
Accession Number	(0008,0050)	RIS or "Accession No." input
Modality	(0008,0060)	XA
Manufacturer	(0008,0070)	Siemens
Institution Name	(0008,0080)	"Institution Name" input
Referring Physician's Name	(0008,0090)	RIS or input
Station Name	(0008,1010)	from Configuration (VB22x and later)
Study Description	(0008,1030)	"Study" input
Series Description	(0008,103E)	"Organ Program" input or "Organ Program"+(REF)/(SM)/(FLM) or one of : STUDY REPORT, CARE GRAPH, or QUNAT, DYNAMAP
Performing Physician's Name	(0008,1050)	"Performing Physician 1" \ "Performing Physician 2" input
Operator's Name	(0008,1070)	"Operator 1" \"Operator 2" input
Admitting Diagnosis Description	(0008,1080)	RIS or "Admitting Diagnoses" input
Manufacturer's Model Name	(0008,1090)	AXIOM-Artis
Referenced Patient Sequence	(0008,1120)	from RIS
>Referenced SOP Class UID	(0008,1150)	
>Referenced SOP Instance UID	(0008,1155)	
Referenced Image Sequence	(0008,1140)	Reference to related Plane with BIPLANE A/B Instances
>Referenced SOP Class UID	(0008,1150)	
>Referenced SOP Instance UID	(0008,1155)	
Derivation Description	(0008,2111)	Notes about transformation steps
Start Trim	(0008,2142)	<1st frame to display>
Stop Trim	(0008,2143)	<last frame to display>
Recommended Display Frame Rate	(0008,2144)	(in f/s)
Patient's Name	(0010,0010)	RIS or "Patient Name" input
Patient ID	(0010,0020)	RIS or "Patient ID" input
Patient's Birth Date	(0010,0030)	RIS or checked "DoB" input
Patient's Sex	(0010,0040)	RIS or input (M or F or O/unknown)
Patient's Age	(0010,1010)	calculated from "DoB" input
Patient's Size	(0010,1020)	(in meters)
Patient's Weight	(0010,1030)	(in kilograms)
Patient's Address	(0010,1040)	"Address" input

Attribute Name	Tag	Value
Medical Alerts	(0010,2000)	from RIS
Contrast Allergies	(0010,2110)	from RIS
Pregnancy Status	(0010,211C)	from RIS
Patient Comments	(0010,4000)	"Additional Info" input
Contrast Bolus Agent	(0018,0010)	
Cine Rate	(0018,0040)	<acquired frame rate> (in f/s)
KVP	(0018,0060)	<peak KV used> (KV)
Device Serial Number	(0018,1000)	<modality serial number>
Software Version	(0018,1020)	
Protocol Name	(0018,1030)	"Organ Program" input
Contrast Bolus Ingredient	(0018,1048)	
Frame Time	(0018,1063)	(msec/frame)
Frame Time Vector	(0018,1065)	<number of Frame values>(msec)
Distance Source to Detector	(0018,1110)	(mm)
Distance Source to Patient	(0018,1111)	(mm)
Estimated Radiographic Magnification Factor	(0018,1114)	<Ratio of SID/SOD> (Will be updated by calibration. Is to be used in conjunction with Imager Pixel Spacing to derive Pixel Size in selected Patient Plane).
Exposure Time	(0018,1150)	<duration of x-Ray exposure> (msec)
X-Ray Tube Current	(0018,1151)	(mA)
Average Pulse Width	(0018,1154)	(msec)
Radiation Setting	(0018,1155)	SC | GR
Radiation Mode	(0018,115A)	CONTINUOUS | PULSED
Image Area Dose Product	(0018,115E)	(dGy*cm*cm)
Intensifier Size	(0018,1162)	<(zoomed) diameter> (mm)
Imager Pixel Spacing	(0018,1164)	<row space, col space>(mm) Phys. Distance calculated from II diameter, II Zoom and select Matrix Size (512 or 1024). **NO calibration factor** ! (see [0018,1114])
Focal Spot	(0018,1190)	
Positioner Motion	(0018,1500)	DYNAMIC | STATIC
Positioner Primary Angle	(0018,1510)	(degrees); 0 with DYNAMIC
Positioner Secondary Angle	(0018,1511)	(degrees); 0 with DYNAMIC
Positioner Primary Angle Increment	(0018,1520)	Only with DYNAMIC (absolute values)
Positioner Secondary Angle Increment	(0018,1521)	Only with DYNAMIC (absolute values)
Detector Primary Angle	(0018,1530)	
Detector Secondary Angle	(0018,1531)	
Shutter Shape	(0018,1600)	RECTANGULAR and/or CIRCULAR and/or POLYGONAL
Shutter Left Vertical Edge	(0018,1602)	<column number left edge>
Shutter Right Vertical Edge	(0018,1604)	<column number right edge>
Shutter Upper Horizontal Edge	(0018,1606)	<row number upper edge>
Shutter Lower Horizontal Edge	(0018,1608)	<row number lower edge>
Center of Circular Shutter	(0018,1610)	<row number>,<column number>
Radius of Circular Shutter	(0018,1612)	<number of pixels in row direction>
Vertices of the Polygonal Shutter	(0018,1620)	<list of row/column coordinate pairs>
Collimator Shape	(0018,1700)	RECTANGULAR and/or CIRCULAR and/or POLYGONAL
Collimator Left Vertical Edge	(0018,1702)	<column number left edge>
Collimator Right Vertical Edge	(0018,1704)	<column number right edge>
Collimator Upper Horizontal Edge	(0018,1706)	<row number upper edge>
Collimator Lower Horizontal Edge	(0018,1708)	<row number lower edge>
Center of Circular Collimator	(0018,1710)	<row number>,<column number>
Radius of Circular Collimator	(0018,1712)	<number of pixels in row direction>
Vertices of the Polygonal Collimator	(0018,1720)	<list of row/column coordinate pairs>

Attribute Name	Tag	Value
Patient Position	(0018,5100)	mandatory “Patient Position” input
Private Creator	(0019,00xx)	SIEMENS SMS-AX VIEW 1.0
Attributes according to “A.2.6 Angio Viewing Module”		
Study Instance UID	(0020,000D)	RIS or system generated
Series Instance UID	(0020,000E)	
Study ID	(0020,0010)	
Series Number	(0020,0011)	
Acquisition Number	(0020,0012)	
Image Number	(0020,0013)	
Patient Orientation	(0020,0020)	calculated from “Patient Position” input and from Gantry coordinate data.
Laterality	(0020,0060)	input via L or R marker annotation, else absent
Images in Acquisition	(0020,1002)	
Image Comments	(0020,4000)	zero length or "SM" or "REF"
Private Creator	(0021,00xx)	SIEMENS SMS-AX ACQ 1.0
Attributes according to “A.2.7 Angio Acquisition Data Module”		
Private Creator	(0025,00xx)	SIEMENS SMS-AX ORIGINAL IMAGE INFO 1.0
Attributes according to “A.2.9 Original Image Info Module” (only if derived image)		
Samples per Pixel	(0028,0002)	1
Photometric Interpretation	(0028,0004)	MONOCHROME2
Rows	(0028,0010)	512 | 1024
Columns	(0028,0011)	512 | 1024
Bits Allocated	(0028,0100)	8 | 16
Bits Stored	(0028,0101)	8 | 12
High Bit	(0028,0102)	7 | 11
Pixel Representation	(0028,0103)	0
Pixel Intensity Relationship	(0028,1040)	LIN | LOG | DISP
Window Center	(0028,1050)	<NAT value>
Window Width	(0028,1051)	<NAT value>
Recommended Viewing Mode	(0028,1090)	SUB | NAT
Lossy Image Compression	(0028,2110)	
Modality LUT Sequence	(0028,3000)	(if [0028,1040] = LOG)
>LUT Descriptor	(0028,3002)	<num of LUT entries>, <first pixel val mapped>, <Entry bits alloc>
>Modality LUT Type	(0028,3004)	US
>LUT Data	(0028,3006)	<array of data, accord. descriptor>
Representative Frame Number	(0028,6010)	<e.g. frame number of Icon Image>
Mask Subtraction Sequence	(0028,6100)	
>Mask Operation	(0028,6101)	AVG_SUB
>Mask Frame Numbers	(0028,6110)	<numbers> (only for AVG_SUB)
Private Creator	(0029,00xx)	CARDIO-D.R. 1.0
Attributes according to “A.2.5 Edge Enhancement Module” – 2 items		
Study Status ID	(0032,000A)	only with RIS patient
Scheduled Study Start Date	(0032,1000)	only with RIS patient
Scheduled Study Start Time	(0032,1001)	only with RIS patient
Scheduled Study Location	(0032,1020)	only with RIS patient
Scheduled Study Location AE Title(s)	(0032,1020)	only with RIS patient
Requesting Physician	(0032,1032)	from RIS
Requested Procedure Description	(0032,1060)	from RIS
Requested Contrast Agent	(0032,1070)	from RIS
Study Comments	(0032,4000)	"Exam Comment" input
Special Needs	(0038,0050)	from RIS
Patient State	(0038,0500)	from RIS
Performed Procedure Step Start Date	(0040,0244)	supplied, even if MPPS SOP class is not supported

Attribute Name	Tag	Value
Performed Procedure Step Start Time	(0040,0245)	supplied, even if MPPS SOP class is not supported
Performed Procedure Step ID	(0040,0235)	supplied, even if MPPS SOP class is not supported "XAyyyymmddhhmmss" is set with 1st Image acquired
Request Attributes Sequence	(0040,0275)	only if SOP is done under Scheduled Procedure Step, else Sequence is not encoded
>Scheduled Procedure Step Description	(0040,0007)	from RIS
>Scheduled Procedure Step ID	(0040,0009)	from RIS
>Requested Procedure ID	(0040,1001)	from RIS or “Request ID” input
Confidentiality Constraint on Patient Data Description	(0040,3001)	from RIS
Curve Dimensions	(5000,0005)	2
Number of Points	(5000,0010)	<number of data points>
Type of Data	(5000,0020)	ECG
Axis Units	(5000,0030)	DPPS\NONE (DPPS = data points per second)
Data Value Representation	(5000,0103)	0000h
Curve Data Descriptor	(5000,0110)	0\1
Coordinate Start Value	(5000,0112)	0
Coordinate Step Value	(5000,0114)	<sampling rate>
Curve Data	(5000,3000)	
Overlay Rows	(60xx,0010)	same as (0028,0010)
Overlay Columns	(60xx,0011)	same as (0028,0011)
Number of Frames in Overlay	(60xx,0015)	<number>
Overlay Description	(60xx,0022)	
Overlay Type	(60xx,0040)	G
Overlay Origin	(60xx,0050)	1\1
Image Frame Origin	(60xx,0051)	<1-based number>
Overlay Bits Allocated	(60xx,0100)	same as (0028,0100) or 1 (if Overlay encoded in [60xx,3000])
Overlay Bit Position	(60xx,0102)	12 or 0 (if Overlay encoded in [60xx,3000])
Overlay Data	[60xx,3000]	(with Offline Media Instances) Graphics Overlay
Pixel Data	(7FE0,0010)	

A.5 Private Non-Image IOD

The AXIOM Artis system will create numerical data that cannot be correlated to an individual image instance and therefore need to be stored in separate instance(s). This is necessary to correlate the information in the right level of the DICOM data model hierarchy. Since there is no fitting DICOM SOP Class definition, SIEMENS has created a private "Non-Image IOD" to contain numerical data heaps to be managed within a DICOM structure. Please see previous chapters of the Appendix for IOD definition and the following tables for detailed encoding of the different "Non-Image SOP Class Instances".

“*overview of supplied attributes – Non-Image (Study Report)”*

Attribute Name	Tag	Value
Specific Character Set	(0008,0005)	from Configuration
Image Type	(0008,0008)	ORIGINAL\PRIMARY\SINGLE PLANE\\STUDY REPORT
SOP Class UID	(0008,0016)	1.3.12.2.1107.5.9.1
SOP Instance UID	(0008,0018)	
Study Date	(0008,0020)	<yyyymmdd>
Series Date	(0008,0021)	<yyyymmdd>
Study Time	(0008,0030)	<hhmmss>
Series Time	(0008,0031)	<hhmmss>
Accession Number	(0008,0050)	RIS or "Accession Number" input

Attribute Name	Tag	Value
Modality	(0008,0060)	XA
Manufacturer	(0008,0070)	Siemens
Institution Name	(0008,0080)	
Performing Physician´s Name	(0008,1050)	"Performing Physician 1" \ "Performing Physician 2" input
Admitting Diagnosis Description	(0018,1080)	RIS or "Admitting Diagnoses" input
Manufacturer´s Model Name	(0008,1090)	AXIOM Artis
Patient´s Name	(0010,0010)	RIS or "Patient Name" input
Patient ID	(0010,0020)	RIS or "Patient ID" input
Patient´s Birth Date	(0010,0030)	RIS or checked input
Patient´s Sex	(0010,0040)	RIS or input (M or F or O/unknown)
Patient's Age	(0010,1010)	calculated from "DoB" input
Patient's Size	(0010,1020)	(in meters)
Patient's Weight	(0010,1030)	(in kilograms)
Patient's Address	(0010,1040)	“Adress” input
Patient Comments	(0010,4000)	"Additional Info" input
Protocol Name	(0018,1030)	STUDY REPORT
Study Instance UID	(0020,000D)	from RIS or system generated
Series Instance UID	(0020,000E)	
Study ID	(0020,0010)	
Series Number	(0020,0011)	
Private Creator	(0029,00xx)	SIEMENS CSA NON-IMAGE
Data Type	(0029,xx08)	BSR REPORT
Data Version	(0029,xx09)	1.0
Requested Procedure Description	(0032,1060)	from RIS
Study Comments	(0032,4000)	"Exam Comment" input
Private Creator	(7FE1,00xx)	SIEMENS CSA NON-IMAGE
Data	(7FE1,xx10)	<Study Report data> (encoded as 8-Bit ASCII data, with <LF> as line separator)

A.6 Quant Report images - Derived XA IOD

The MAS System will create result images form performing Qunatitative Analysis Functions. To ensure image interchange, the resulting reports are converted to XA multi-frames with dedicated header data.

“*overview of supplied attributes – XA Angiographic image (Quant Report Image)”*

Attribute Name	Tag	Value
Specific Character Set	(0008,0005)	(conf. Character Set is added, if needed)
Image Type	(0008,0008)	DERIVED\SECONDARY\<3rd to nth value from Original>\QUANT
SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.12.1
SOP Instance UID	(0008,0018)	
Study Date	(0008,0020)	<yyyymmdd>
Series Date	(0008,0021)	<yyyymmdd> (Quant Series)
Acquisition Date	(0008,0022)	Date of Original Acquisition
Image Date	(0008,0023)	<yyyymmdd> (Date of Creation)
Study Time	(0008,0030)	<hhmmss>
Series Time	(0008,0031)	<hhmmss> (Quant Series)
Acquisition Time	(0008,0032)	Time of Original Acquisition
Image Time	(0008,0033)	<hhmmss> (Time of Creation)
Accession Number	(0008,0050)	from Original
Modality	(0008,0060)	XA
Manufacturer	(0008,0070)	Siemens

Attribute Name	Tag	Value
Institution Name	(0008,0080)	from Original
Referring Physician´s Name	(0008,0090)	from Original
Station Name	(0008,1010)	from Configuration (VB22x and later)
Study Description	(0008,1030)	from Original
Series Description	(0008,103E)	input from Analysis
Performing Physician´s Name	(0008,1050)	from Original
Operator´s Name	(0008,1070)	from Original
Admitting Diagnosis Description	(0008,1080)	from Original
Manufacturer´s Model Name	(0008,1090)	AXIOM Artis
Referenced Patient Sequence	(0008,1120)	from RIS
>Referenced SOP Class UID	(0008,1150)	
>Referenced SOP Instance UID	(0008,1155)	
Start Trim	(0008,2142)	<1st frame to display>
Stop Trim	(0008,2143)	<last frame to display>
Recommended Display Frame Rate	(0008,2144)	1
Patient´s Name	(0010,0010)	from Original
Patient ID	(0010,0020)	from Original
Patient´s Birth Date	(0010,0030)	from Original
Patient´s Sex	(0010,0040)	from Original
Patient's Age	(0010,1010)	from Original
Patient's Size	(0010,1020)	(in meters)
Patient's Weight	(0010,1030)	(in kilograms)
Patient's Address	(0010,1040)	from Original
Patient Comments	(0010,4000)	from Original
Contrast Bolus Agent	(0018,0010)	from Original
Cine Rate	(0018,0040)	1
KVP	(0018,0060)	from Original
Device Serial Number	(0018,1000)	
Software Version	(0018,1020)	
Protocol Name	(0018,1030)	from Original
Contrast Bolus Ingredient	(0018,1048)	from Original
Frame Time	(0018,1063)	1000
Distance Source to Detector	(0018,1110)	from Original
Distance Source to Patient	(0018,1111)	from Original
Estimated Radiographic Magnification Factor	(0018,1114)	from Original (Will be updated by calibration. Is to be used in conjunction with Imager Pixel Spacing to derive Pixel Size in selected Patient Plane).
Exposure Time	(0018,1150)	from Original
X-Ray Tube Current	(0018,1151)	from Original
Average Pulse Width	(0018,1154)	from Original
Radiation Setting	(0018,1155)	from Original
Radiation Mode	(0018,115A)	from Original
Image Area Dose Product	(0018,115E)	from Original
Intensifier Size	(0018,1162)	from Original
Imager Pixel Spacing	(0018,1164)	<row space, col space>(mm) Phys. Distance calculated from II diameter, II Zoom and select Matrix Size (512 or 1024). **NO calibration factor** ! (see [0018,1114])
Focal Spot	(0018,1190)	from Original
Positioner Motion	(0018,1500)	from Original
Positioner Primary Angle	(0018,1510)	from Original
Positioner Secondary Angle	(0018,1511)	from Original
Positioner Primary Angle Increment	(0018,1520)	from Original (Only with DYNAMIC)
Positioner Secondary Angle Increment	(0018,1521)	from Original (Only with DYNAMIC)
Detector Primary Angle	(0018,1530)	from Original

Attribute Name	Tag	Value
Detector Secondary Angle	(0018,1531)	from Original
Patient Position	(0018,5100)	from Original
Private Creator	(0019,00xx)	SIEMENS SMS-AX VIEW 1.0
Review Mode	(0019,xx00)	if existent in Original (Siemens AXIOM system)
Anatomical Background Percent	(0019,xx01)	as set
Number of Phases	(0019,xx02)	if existent in Original (Siemens AXIOM system)
Apply Anatomical Background	(0019,xx03)	as set
Pixel Shift Array	(0019,xx04)	as set
Brightness	(0019,xx05)	as set
Contrast	(0019,xx06)	as set
Enabled Shutters	(0019,xx07)	as set
Native Edge Enhancement Percent Gain	(0019,xx08)	as set
Native Edge Enhancement LUT Index	(0019,xx09)	as set
Native Edge Enhancement Kernel Size	(0019,xx0A)	as set
Subtracted Edge Enhancement Percent Gain	(0019,xx0B)	as set
Subtracted Edge Enhancement LUT Index	(0019,xx0C)	as set
Subtracted Edge Enhancement Kernel Size	(0019,xx0D)	as set
Fade Percent	(0019,xx0E)	as set
Flipped before Laterality applied	(0019,xx0F)	
Apply Fade	(0019,xx10)	as set
Study Instance UID	(0020,000D)	from Original
Series Instance UID	(0020,000E)	
Study ID	(0020,0010)	from Original
Series Number	(0020,0011)	
Acquisition Number	(0020,0012)	from Original
Image Number	(0020,0013)	
Patient Orientation	(0020,0020)	From Original or zero length
Images in Acquisition	(0020,1002)	
Private Creator	(0021,00xx)	SIEMENS SMS-AX ACQ 1.0
Attributes according to "A.2.7 Angio Acquisition Data Module"		
Private Creator	(0023,00xx)	SIEMENS SMS-AX QUANT 1.0
Horizontal Calibration Pixel Size	(0023,xx00)	
Vertical Calibration Pixel Size	(0023,xx01)	
Calibration Object	(0023,xx02)	
Calibration Object Size	(0023,xx03)	
Calibration Method	(0023,xx04)	
File Name	(0023,xx05)	
Frame Number	(0023,xx06)	
Calibration Factor Multiplicity	(0023,xx07)	
Samples per Pixel	(0028,0002)	1
Photometric Interpretation	(0028,0004)	MONOCHROME2
Number of Frames	(0028,0008)	1 to 4
Frame Increment Pointer	(0028,0009)	(0018,1063)
Rows	(0028,0010)	1024
Columns	(0028,0011)	1024
Bits Allocated	(0028,0100)	16
Bits Stored	(0028,0101)	12
High Bit	(0028,0102)	11
Pixel Representation	(0028,0103)	0
Pixel Intensity Relationship	(0028,1040)	LIN
Window Center	(0028,1050)	2048
Window Width	(0028,1051)	4095
Representative Frame Number	(0028,6010)	1

Attribute Name	Tag	Value
Requested Procedure Description	(0032,1060)	from Original
Study Comments	(0032,4000)	from Original
Performed Procedure Step Start Date	(0040,0244)	from Original
Performed Procedure Step Start Time	(0040,0245)	from Original
Performed Procedure Step ID	(0040,0235)	from Original
Request Attributes Sequence	(0040,0275)	from Original
> item contents as provided		
Confidentiality Constraint on Patient Data Description	(0040,3001)	from Original
Pixel Data	(7FE0,0010)	

A.7 CT/MR Images Converted to XA IOD (VA22x and later)

The Artis system will create reference images from CT or MR images. Those will be encoded as derived XA Standard Extended SOP Class. Please see the following tables for a complete overview of supplied Type 1/2/3 Standard and additional Private Attributes:

"*overview of supplied attributes – X-Ray Angiographic image(Derived) from **CT** image"*

Attribute Name	Tag	Value
Specific Character Set	(0008,0005)	from Configuration
Image Type	(0008,0008)	see "A.2.10 SOP Common Module – Image Type Extentions" (Ref Image)
SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.12.1
SOP Instance UID	(0008,0018)	<new UID>
Study Date	(0008,0020)	from Original or changed by CorRea (Drag&Drop)
Series Date	(0008,0021)	<yyyymmdd>
Acquisition Date	(0008,0022)	Date of Original Acquisition, if provided by CT
Image Date	(0008,0023)	<yyyymmdd> (Date of Creation)
Study Time	(0008,0030)	from Original or changed by CorRea (Drag&Drop)
Series Time	(0008,0031)	<hhmmss>
Acquisition Time	(0008,0032)	Time of Original Acquisition, if provided by CT
Image Time	(0008,0033)	<hhmmss> (Time of Creation)
Accession Number	(0008,0050)	from Original or changed by CorRea (Drag&Drop)
Modality	(0008,0060)	XA
Manufacturer	(0008,0070)	Siemens
Institution Name	(0008,0080)	from Original (equipment)
Referring Physician's Name	(0008,0090)	from Original or changed by CorRea (Drag&Drop)
Station Name	(0008,1010)	Artis Station Name (VB22x and later)
Study Description	(0008,1030)	from Original or changed by CorRea (Drag&Drop)
Series Description	(0008,103E)	CT REF
Institutional Department Name	(0008,1040)	from Original (equipment))
Performing Physician's Name	(0008,1050)	from Original (series)
Operator's Name	(0008,1070)	from Original (series)
Admitting Diagnosis Description	(0008,1080)	from Original or changed by CorRea (Drag&Drop)
Manufacturer's Model Name	(0008,1090)	AXIOM Artis
Source Image Sequence	(0008,2112)	Reference to original CT image
>Referenced SOP Class UID	(0008,1150)	1.2.840.10008.5.1.4.1.1.2 (CT image)
>Referenced SOP Instance UID	(0008,1155)	from Original [0008,0018]
Patient's Name	(0010,0010)	from Original or changed by CorRea (Drag&Drop)
Patient ID	(0010,0020)	from Original or changed by CorRea (Drag&Drop)
Patient's Birth Date	(0010,0030)	from Original or changed by CorRea (Drag&Drop)
Patient's Sex	(0010,0040)	from Original or changed by CorRea (Drag&Drop)
Patient's Age	(0010,1010)	from Original or changed by CorRea (Drag&Drop)
Patient's Size	(0010,1020)	from Original or changed by CorRea (Drag&Drop)
Patient's Weight	(0010,1030)	from Original or changed by CorRea (Drag&Drop)
Patient's Address	(0010,1040)	from Original or changed by CorRea (Drag&Drop)
Patient Comments	(0010,4000)	from Original or changed by CorRea (Drag&Drop)
Contrast Bolus Agent	(0018,0010)	from Original (Contrast/bolus)
KVP	(0018,0060)	from Original (image)
Device Serial Number	(0018,1000)	<Artis Serial number>
Software Version	(0018,1020)	<Artis Software Version>
Protocol Name	(0018,1030)	from Original "Series Description"
Contrast Bolus Ingredient	(0018,1048)	from Original (Contrast/bolus)
Distance Source to Detector	(0018,1110)	<zero length>
Distance Source to Patient	(0018,1111)	<zero length>
Estimated Radiographic Magnification Factor	(0018,1114)	1.0

Attribute Name	Tag	Value
Exposure Time	(0018,1150)	from Original (CT image)
X-Ray Tube Current	(0018,1151)	from Original (CT image)
Average Pulse Width	(0018,1154)	<zero length>
Radiation Setting	(0018,1155)	GR
Radiation Mode	(0018,115A)	<zero length>
Image Area Dose Product	(0018,115E)	<zero length>
Intensifier Size	(0018,1162)	<zero length>
Imager Pixel Spacing	(0018,1164)	values taken from original "[0028,0030] Pixel Spacing" (Image plane)
Grid	(0018,1166)	NONE
Positioner Motion	(0018,1500)	<zero length>
Positioner Primary Angle	(0018,1510)	<zero length>
Positioner Secondary Angle	(0018,1511)	<zero length>
Detector Primary Angle	(0018,1530)	<zero length>
Detector Secondary Angle	(0018,1531)	<zero length>
Private Creator	(0019,00xx)	SIEMENS SMS-AX VIEW 1.0
Attributes according to "A.2.6 Angio Viewing Module" (created, if required)		
Study Instance UID	(0020,000D)	from Original or changed by CorRea (Drag&Drop)
Series Instance UID	(0020,000E)	<new UID>
Study ID	(0020,0010)	from Original or changed by CorRea (Drag&Drop)
Series Number	(0020,0011)	"1000-based" counter
Acquisition Number	(0020,0012)	from Original (Image)
Image Number	(0020,0013)	"2000-based" counter
Patient Orientation	(0020,0020)	from Original (Series)
Images in Acquisition	(0020,1002)	
Image Comments	(0020,4000)	from Original (Image)
Private Creator	(0021,00xx)	SIEMENS SMS-AX ACQ 1.0
Attributes according to "A.2.7 Angio Acquisition Data Module" (created, if required)		
Samples per Pixel	(0028,0002)	1
Photometric Interpretation	(0028,0004)	MONOCHROME2
Rows	(0028,0010)	from Original (Image) only 512 supported
Columns	(0028,0011)	from Original (Image) only 512 supported
Bits Allocated	(0028,0100)	16
Bits Stored	(0028,0101)	12 (converted)
High Bit	(0028,0102)	11 (converted)
Pixel Representation	(0028,0103)	0 (converted to unsigned)
Pixel Intensity Relationship	(0028,1040)	LIN or DISP
Window Center	(0028,1050)	calculated from Original Window Center and Rescale Intercept (VOI LUT, MOD LUT)
Window Width	(0028,1051)	from Original (VOI LUT)
Lossy Image Compression	(0028,2110)	from Original (Image)
Requested Procedure Description	(0032,1060)	from Original (syngo)
Study Comments	(0032,4000)	from Original or changed by CorRea (Drag&Drop)
Performed Procedure Step Start Date	(0040,0244)	from Original (Series), if existent
Performed Procedure Step Start Time	(0040,0245)	from Original (Series), if existent
Performed Procedure Step ID	(0040,0235)	from Original (Series), if existent
Request Attributes Sequence	(0040,0275)	from Original (Series), if existent
>Scheduled Procedure Step Description	(0040,0007)	as set from Original (Series)
>Scheduled Procedure Step ID	(0040,0009)	as set from Original (Series)
>Requested Procedure ID	(0040,1001)	as set from Original (Series)
Overlay Rows	(60xx,0010)	same as (0028,0010)
Overlay Columns	(60xx,0011)	same as (0028,0011)
Overlay Description	(60xx,0022)	from Original (Overlay)
Overlay Type	(60xx,0040)	from Original (Overlay)

Attribute Name	Tag	Value
Overlay Origin	(60xx,0050)	from Original (Overlay)
Overlay Bits Allocated	(60xx,0100)	from Original (Overlay)
Overlay Bit Position	(60xx,0102)	from Original (Overlay)
Overlay Data	[60xx,3000]	from Original (Overlay)
Pixel Data	(7FE0,0010)	possibly converted from original pixel data

"*overview of supplied attributes – X-Ray Angiographic image(Derived) from **MR** image"*

Attribute Name	Tag	Value
Specific Character Set	(0008,0005)	from Configuration
Image Type	(0008,0008)	see "A.2.10 SOP Common Module – Image Type Extentions" (Ref Image)
SOP Class UID	(0008,0016)	1.2.840.10008.5.1.4.1.1.12.1
SOP Instance UID	(0008,0018)	<new UID>
Study Date	(0008,0020)	from Original or changed by CorRea (Drag&Drop)
Series Date	(0008,0021)	<yyyymmdd>
Acquisition Date	(0008,0022)	Date of Original Acquisition, if provided by MR
Image Date	(0008,0023)	<yyyymmdd> (Date of Creation)
Study Time	(0008,0030)	from Original or changed by CorRea (Drag&Drop)
Series Time	(0008,0031)	<hhmmss>
Acquisition Time	(0008,0032)	Time of Original Acquisition, if provided by MR
Image Time	(0008,0033)	<hhmmss> (Time of Creation)
Accession Number	(0008,0050)	from Original or changed by CorRea (Drag&Drop)
Modality	(0008,0060)	XA
Manufacturer	(0008,0070)	Siemens
Institution Name	(0008,0080)	from Original (equipment)
Referring Physician's Name	(0008,0090)	from Original or changed by CorRea (Drag&Drop)
Station Name	(0008,1010)	Artis Station Name (VB22x and later)
Study Description	(0008,1030)	from Original or changed by CorRea (Drag&Drop)
Series Description	(0008,103E)	MR REF
Institutional Department Name	(0008,1040)	from Original (equipment))
Performing Physician's Name	(0008,1050)	from Original (series)
Operator's Name	(0008,1070)	from Original (series)
Admitting Diagnosis Description	(0008,1080)	from Original or changed by CorRea (Drag&Drop)
Manufacturer's Model Name	(0008,1090)	AXIOM Artis
Source Image Sequence	(0008,2112)	Reference to original MR image
>Referenced SOP Class UID	(0008,1150)	1.2.840.10008.5.1.4.1.1.4 (MR image)
>Referenced SOP Instance UID	(0008,1155)	from Original [0008,0018]
Patient's Name	(0010,0010)	from Original or changed by CorRea (Drag&Drop)
Patient ID	(0010,0020)	from Original or changed by CorRea (Drag&Drop)
Patient's Birth Date	(0010,0030)	from Original or changed by CorRea (Drag&Drop)
Patient's Sex	(0010,0040)	from Original or changed by CorRea (Drag&Drop)
Patient's Age	(0010,1010)	from Original or changed by CorRea (Drag&Drop)
Patient's Size	(0010,1020)	from Original or changed by CorRea (Drag&Drop)
Patient's Weight	(0010,1030)	from Original or changed by CorRea (Drag&Drop)
Patient's Address	(0010,1040)	from Original or changed by CorRea (Drag&Drop)
Patient Comments	(0010,4000)	from Original or changed by CorRea (Drag&Drop)
Contrast Bolus Agent	(0018,0010)	from Original (Contrast/bolus)
KVP	(0018,0060)	<zero length>
Device Serial Number	(0018,1000)	<Artis Serial number>
Software Version	(0018,1020)	<Artis Software Version>
Protocol Name	(0018,1030)	from Original(Series)
Contrast Bolus Ingredient	(0018,1048)	from Original (Contrast/bolus)
Distance Source to Detector	(0018,1110)	<zero length>

Attribute Name	Tag	Value
Distance Source to Patient	(0018,1111)	<zero length>
Estimated Radiographic Magnification Factor	(0018,1114)	1.0
Exposure Time	(0018,1150)	<zero length>
X-Ray Tube Current	(0018,1151)	<zero length>
Average Pulse Width	(0018,1154)	<zero length>
Radiation Setting	(0018,1155)	SC (even if created w/o radiation!)
Radiation Mode	(0018,115A)	<zero length>
Image Area Dose Product	(0018,115E)	<zero length>
Intensifier Size	(0018,1162)	<zero length>
Imager Pixel Spacing	(0018,1164)	values taken from original "[0028,0030] Pixel Spacing" (Image plane)
Grid	(0018,1166)	NONE
Positioner Motion	(0018,1500)	<zero length>
Positioner Primary Angle	(0018,1510)	<zero length>
Positioner Secondary Angle	(0018,1511)	<zero length>
Detector Primary Angle	(0018,1530)	<zero length>
Detector Secondary Angle	(0018,1531)	<zero length>
Private Creator	(0019,00xx)	SIEMENS SMS-AX VIEW 1.0
Attributes according to "A.2.6 Angio Viewing Module" (created, if required)		
Study Instance UID	(0020,000D)	from Original or changed by CorRea (Drag&Drop)
Series Instance UID	(0020,000E)	<new UID>
Study ID	(0020,0010)	from Original or changed by CorRea (Drag&Drop)
Series Number	(0020,0011)	"1000-based" counter
Acquisition Number	(0020,0012)	from Original (Image)
Image Number	(0020,0013)	"2000-based" counter
Patient Orientation	(0020,0020)	from Original (Series)
Images in Acquisition	(0020,1002)	
Image Comments	(0020,4000)	from Original (Image)
Private Creator	(0021,00xx)	SIEMENS SMS-AX ACQ 1.0
Attributes according to "A.2.7 Angio Acquisition Data Module" (created, if required)		
Samples per Pixel	(0028,0002)	1
Photometric Interpretation	(0028,0004)	MONOCHROME2
Rows	(0028,0010)	from Original (Image), only 512 supported
Columns	(0028,0011)	from Original (Image), only 512 supported
Bits Allocated	(0028,0100)	16
Bits Stored	(0028,0101)	12 (converted)
High Bit	(0028,0102)	11 (converted)
Pixel Representation	(0028,0103)	0 (converted to unsigned)
Pixel Intensity Relationship	(0028,1040)	LIN or DISP
Window Center	(0028,1050)	calculated from Original Window Center and Rescale Intercept (VOI LUT, MOD LUT)
Window Width	(0028,1051)	from Original (VOI LUT)
Lossy Image Compression	(0028,2110)	from Original (Image)
Requested Procedure Description	(0032,1060)	from Original (syngo)
Study Comments	(0032,4000)	from Original or changed by CorRea (Drag&Drop)
Performed Procedure Step Start Date	(0040,0244)	from Original (Series), if existent
Performed Procedure Step Start Time	(0040,0245)	from Original (Series), if existent
Performed Procedure Step ID	(0040,0235)	from Original (Series), if existent
Request Attributes Sequence	(0040,0275)	from Original (Series), if existent
>Scheduled Procedure Step Description	(0040,0007)	as set from Original (Series)
>Scheduled Procedure Step ID	(0040,0009)	as set from Original (Series)
>Requested Procedure ID	(0040,1001)	as set from Original (Series)
Overlay Rows	(60xx,0010)	same as (0028,0010)
Overlay Columns	(60xx,0011)	same as (0028,0011)

Attribute Name	Tag	Value
Overlay Description	(60xx,0022)	from Original (Overlay)
Overlay Type	(60xx,0040)	from Original (Overlay)
Overlay Origin	(60xx,0050)	from Original (Overlay)
Overlay Bits Allocated	(60xx,0100)	from Original (Overlay)
Overlay Bit Position	(60xx,0102)	from Original (Overlay)
Overlay Data	[60xx,3000]	from Original (Overlay)
Pixel Data	(7FE0,0010)	possibly converted from original pixel data

A.8 Sorting Order AXIOM Artis (VA20F/VA21x/VA22x) with syngo VA47Z/VA49B

This paper discusses the sorting algorithms for Artis within the patient browser and directory overview.

A.8.1 Identification of Images

Identification of Images → / DICOM Attributes ↓	Original acquired images	Store Monitor Image	Store Reference Image	Quant Report Images	Study Report non-image
Image Type (0008,0008)	ORIGINAL\PRIMARY\SINGLE PLANE\SINGLE A ORIGINAL\PRIMARY\SINGLE PLANE\SINGLE B ORIGINAL\PRIMARY\BIPLANE A ORIGINAL\PRIMARY\BIPLANE B ORIGINAL/PRIMARY/SINGLE PLANE/PLANE A/PERI/MASK/n ORIGINAL/PRIMARY/SINGLE PLANE/PLANE A/PERI/FILL/n ORIGINAL/PRIMARY/SINGLE PLANE/PLANE A/DYNA/MASK ORIGINAL/PRIMARY/SINGLE PLANE/PLANE A/DYNA/INJECTION ORIGINAL/PRIMARY/SINGLE PLANE/PLANE A/DYNA/FILL ORIGINAL/PRIMARY/SINGLE PLANE/PLANE A/DYNA/WASHOUT DERIVED\PRIMARY\SINGLE PLANE\SINGLE A\STORE FLUORO DERIVED\PRIMARY\SINGLE PLANE\SINGLE B\STORE FLUORO DERIVED\PRIMARY\BIPLANE A\\STORE FLUORO DERIVED\PRIMARY\BIPLANE B\\STORE FLUORO	DERIVED\SECONDARY\SINGLE PLANE\ SINGLE A\STORE MONITOR DERIVED\SECONDARY\SINGLE PLANE\SINGLE B\STORE MONITOR	DERIVED\SECONDARY\SINGLE PLANE \SINGLE A\REFIMAGE DERIVED\SECONDARY\SINGLE PLANE\ SINGLE B\REFIMAGE	DERIVED\SECONDARY\SINGLE PLANE\ SINGLE A\REFIMAGE DERIVED\SECONDARY\SINGLE PLANE\ SINGLE B\REFIMAGE	DERIVED\SECONDARY\SINGLE PLANE\ SINGLE A\REFIMAGE DERIVED\SECONDARY\SINGLE PLANE\ SINGLE B\REFIMAGE
SOP Class UID (0008,0016)					1.3.12.2.1107.5.9.1
Series Time (0008,0031)	Same as Acquisition Time.	Same as Acquisition Time.. Store Monitor is in the same series	Same as Acquisition Time.. Store Reference image is in the same series	Time this Quant image was created (Quant was performed)	Study Report is allocated with Patient Registration
Acquisition Time (0008,0032)	Time the acquisition of this image was performed				Not set
Content Time (0008,0033)	Same as Acquisition Time (rule for acquired images)	Time this image was created (Store Monitor was performed)	Time this image was created (Store Reference Image was performed)	Time this Quant image was created (Quant was performed)	Not set
Series Number (0008,0031)	Same Number as Acquisition Number.	Same Number as Acquisition Number. (Reference to original Image)	Same Number as Acquisition Number. (Reference to original Image)	Same Number as Acquisition Number. (Reference to original Image)	Fixed value of “999”
Acquisition Number (0020,0012)	Counts number of acquisitions. All images created during performance of this acquisition have the same number.	Counts number of acquisitions. Refers to the acquisition number of the original image where this image was derived from.	Counts number of acquisitions. Refers to the acquisition number of the original image where this image was derived from.	Counts number of acquisitions. Refers to the acquisition number of the original image where this image was derived from.	Not set
Instance Number (0020, 0013)	“1-based” counter for images. Indicates the creation order within this acquisition.	“300-based” counter for images. Indicates the creation order of Store Monitor images within this Series.	“100-based” counter for images. Indicates the creation order of Store Reference images within this Series.	“1-based” counter for images. Quant Reports are stored in new series	Not set

A.8.2 Handling of Performed Procedure Step ID

Each image contains the attribute "Performed Procedure Step ID" (0040,0235), based on a "YYYMMDDHHMMSS" encoding. This date and time is based on the time when the first image is acquired. The "Performed Procedure Step ID" stays the same for all acquired or derived images as long as the patient is re-registered. A re-registered patient with a new study or new series within the existing study will get a newly assigned "Performed Procedure Step ID".

A.8.3 The sorting algorithms of Artis Viewer

AXIOM Artis has implemented sorting algorithms to display DICOM objects in the directory overview in a specific order. Sorting/Grouping in the Viewer Directory Overview occurs according the following rules:

1. Sort by Series Number

2. If Series Number matches: Group on Series Number, Sort by Content Number

3. If Series Number and Content Number each match: Group on Series Number, Sort by Content Time

In the case, that the user has selected "Scenes + Ref Images" or "Scenes + Store Monitor", the reference images or the store monitor images follow directly the image they had been derived from.

Example 1a:

Patient "Test 1" with one Study, three Series with one acquired image, three Store Monitor Images and one Reference Image in each Series. "Scenes" is selected under the "Dir Overview" button

Scene Directory Overview Patient “Test 1”

Study1 Series 1 Image 1	Study1 Series 2 Image 1	Study1 Series 3 Image 1	

Note :

Acquired image
Store Monitor Image
Store Reference Image

Example 1b:

Patient "Test 1" with one Study, three Series with one acquired image, three Store Monitor Images and one Reference Image in each Series. "Scenes + Ref Images" is selected under the "Dir Overview" button

Scene Directory Overview Patient “Test 1”

Study1 Series 1 Image 1	Study1 Series 1 Image 100	Study1 Series 2 Image 1	Study1 Series 2 Image 100
Study1 Series 3 Image 1	Study1 Series 3 Image 100		

Note :

Acquired image
Store Monitor Image
Store Reference Image

Example 1c:

Patient "Test 1" with one Study, three Series with one acquired image, three Store Monitor Images and one Reference Image in each Series. "Scenes + Store Monitor" is selected under the "Dir Overview" button

Scene Directory Overview Patient “Test 1”

Study1 Series 1 Image 1	Study1 Series 1 Image 300	Study1 Series 1 Image 301	Study1 Series 1 Image 302
Study1 Series 2 Image 1	Study1 Series 2 Image 300	Study1 Series 2 Image 301	Study1 Series 2 Image 302
Study1 Series 3 Image 1	Study1 Series 3 Image 300	Study1 Series 3 Image 301	Study1 Series 3 Image 302

Note :

Acquired image
Store Monitor Image
Store Reference Image

Example 1d:

For Scene #2 of Patient "Test 1" now a Quant Report is performed. According to Example 1c, the Overview now sorts as follows:

Scene Directory Overview Patient "Test 1"

Study1 Series 1 Image 1	Study1 Series 1 Image 300	Study1 Series 1 Image 301	Study1 Series 1 Image 302
Study1 Series 2 Image 1	Study1 Series 2 (Quant) Image 1 (Quant) Content Time > *)	Study1 Series 2 Image 300	Study1 Series 2 Image 301
Study1 Series 2 Image 302	Study1 Series 3 Image 1	Study1 Series 3 Image 300	Study1 Series 3 Image 301
Study1 Series 3 Image 302			

Notes :

Acquired image
Store Monitor Image
Store Reference Image
Quant Report Image

***) Quant Image is sorted consecutive to the acquisition image due to more actual content time.**

A.8.4 The sorting algorithms of Artis Browser

Besides the default sorting criteria, Artis supports the following sorting algorithms for the patient browser.

The default syngo sorting settings are as follows

- Artis displays images - within a Series - with the order they had been acquired

- Artis displays Series - within a Study - with the order they had been acquired

- Artis displays Studies - within a Patient - with the order they had been acquired

Therefore the Quant Report Series will not necessarily be displayed adjacent to the original scene, if created later at the end of all scenes.